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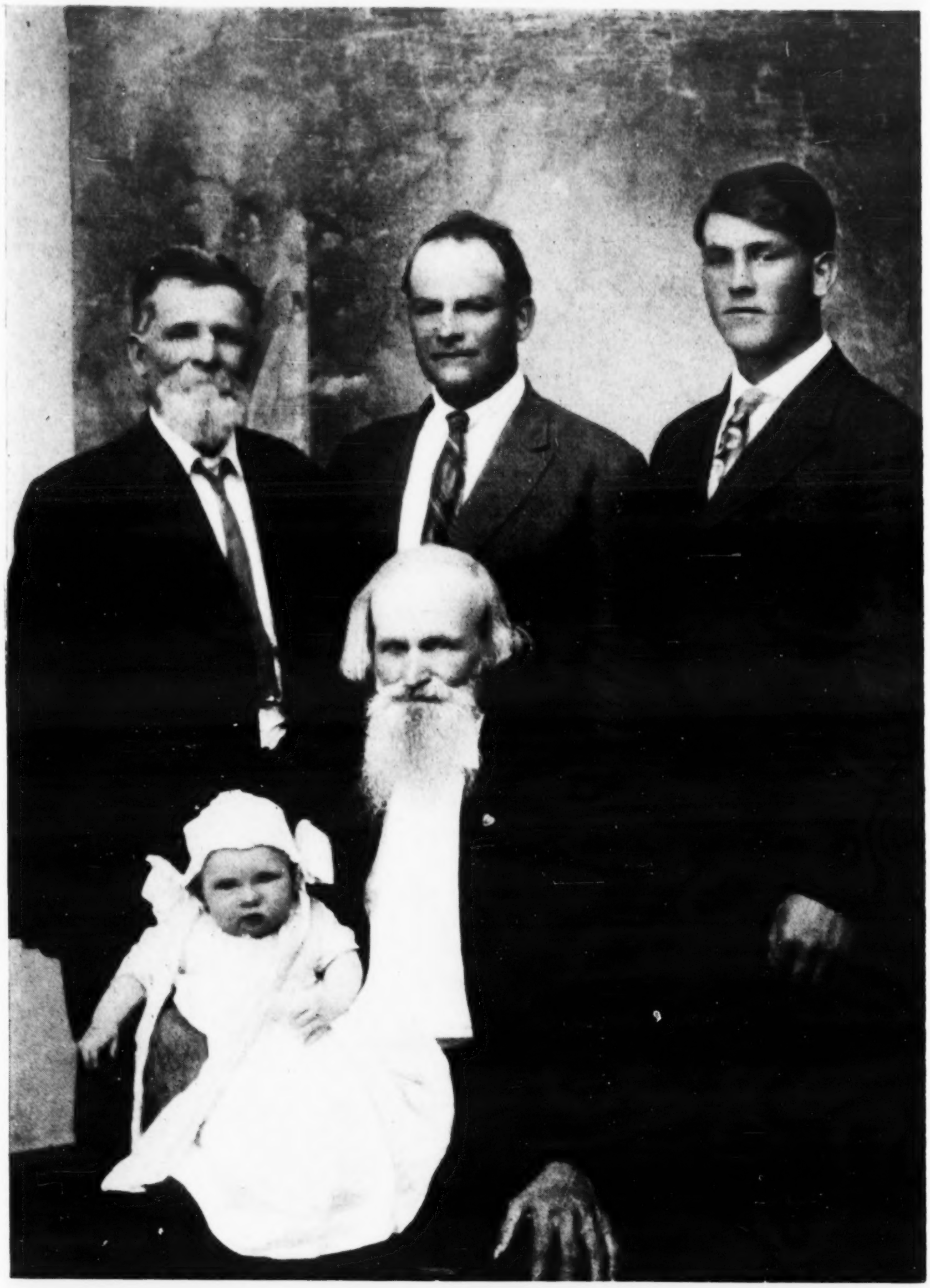

HE HAS 101 DESCENDANTS

Dr. Harvey C. Hullinger of Vernal, Utah, was born in Ohio in 1824; he is, therefore, only 92 years old. His father died at 40 and his mother at 44; nevertheless, the stock from which he comes is a long-lived one, his brothers, sisters, uncles, aunts and grandparents having mostly lived far beyond the usual span. The photograph shows five generations of a single family, the ages of the younger members being: W. S. Hullinger, 68; W. S. Hullinger, Jr., 46; Harvey Hullinger, 20; Wynona Murray Hullinger, 7 months. Photograph taken September, 1915. Dr. Hullinger married three times, and has 14 children, 22 grandchildren, 63 great-grandchildren and 2 great-great-grandchildren. Photograph from the Geneaogical Record Office, Washington. (Frontispiece.)

LONG LIFE MEANS MANY CHILDREN

And Long Life Also Means a Good Inheritance—Study of Longevity Brings Important Proof to the Theory of Evolution

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Plymouth, N. C., Dec. 3.—W. B. Davis, 94 years old and father of 41 children, 33 of whom are alive, got a license Wednesday to wed a Mrs. Mason, 39 years old, who lives near here.

The ceremony was performed yesterday. Twenty-five children and more than a hundred grandchildren of the bridegroom attended.

Mr. Davis has 192 grandchildren and a number of great-grandchildren. This is his fourth venture in matrimony. He is enjoying health, but has complained of being lonesome.

LONG-LIVED parent—many children: the connection seems too obvious to be worth noting.

But it is very well worth noting. The simple fact illustrated in the above newspaper clipping means a great deal not only to eugenics, but to the whole theory of evolution.

First let us make sure of our facts. If we pick at random from the death records the names of two women, one of whom died at the age of 50 and the other at the age of 75, will the longer-lived be found to have left the larger family? Both of them, you must notice, lived past the reproductive period, and it might be supposed that after that period a few years more or less could make no difference.

Nevertheless, the study of Karl Pearson and his associates[1] leaves no doubt that the longest-lived parents have the largest number of offspring. They were able to study family records of some thousands of English and American Quaker families, and reached this conclusion:

"Fertility is correlated with longevity even after the fecund period is passed. If we take American mothers there is no doubt of this increasing fertility even up to 90 years of age. With English mothers it is less marked, but appears to be quite true up to 75 years. Beyond 75 there appears a slight decrease."

In other words, the peculiar physique, the vitality and the toughness of constitution in both men and women, which make longevity possible, are also associated with fecundity. Where you find one, you are likely to find the other. Of two women who both live beyond 50 years, the longer lived is likely to have had, before 50, the larger number of children.

It is not easy to understand why this condition should be more marked for American parents than for English parents, for the American families dealt with were, in the great majority of cases, of Anglo-Saxon race. Evidently climate, mode of life, and similar influences are bringing about a difference in this respect, between the English and the Anglo-American stocks.

Remembering that long life is associated with numerous offspring, let us now recall that long life is due primarily to heredity. Contrary to what one might suppose, people do not attain to a great age because of any particular habits of life, any particular kind of diet or brand of beverage. They live long because they come of a long-lived stock, because they have inherited the kind of constitution that, in circumstances which are reasonably favorable, will stand the strain of existence for an unusually long time.

We are now in a position to see how the connection between long life and large families will assist us in understanding how evolution works.

In the first place, Darwin and many others have shown that the members of a race least fitted to their surroundings are removed by death. For example, of two children born in a neighborhood where tuberculosis is abundant, the one with an inherited resistance is pretty

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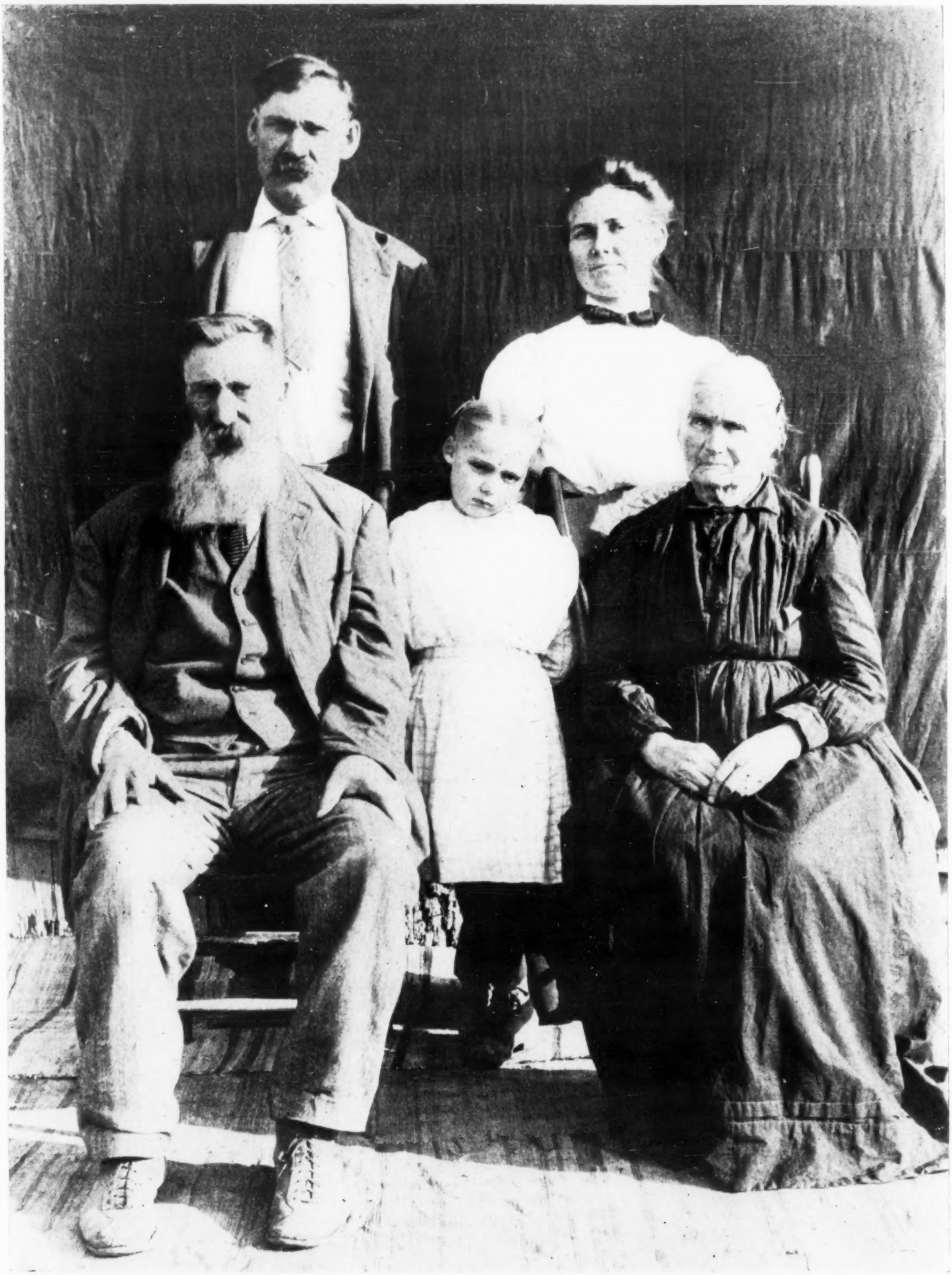
[1] On the Correlation between Duration of Life and the Number of Offspring. By Miss M. Beeton, G. U. Yule and Karl Pearson. Proc. R. S. London, 67 (1900), pp. 159-171.



DESCENDANTS IN FOUR GENERATIONS

Mrs. Mary Erickson of Stahl, Mo., was born in Kentucky in 1821, and is therefore 95 years old. She is the eldest of 11 children, the rest of whom died at from 50 to 60 years of age. Her father died at the age of 56 and her mother at 57. She is, therefore, well above the average longevity of her family, a fact which may be due partly to the more remote ancestors, but which she attributes to hard work, plain food and regular habits. The photograph (from the Genealogical Record Office, Washington) shows her with her eldest son, eldest grandson, eldest great-granddaughter and eldest great-great-granddaughter. (Fig. 1.)

sure to live longer than the one who lacks an inherited resistance.

But if each of them survived to adult life and left an equal number of children, it is obvious that the character of the race would not be changed—there would be relatively just the same numbers of weak and strong persons (in respect to tuberculosis-resistance) in it in the next generation, that there are in this.

The theory of natural selection requires that the weaker of the two individuals whom we have picked out for an illustration, must leave fewer offspring than the strong one. The less fit must leave fewer descendants than the more fit. Thus the race progresses a little in each generation, in the direction of greater fitness in this respect.

THEORY CONFORMS TO FACTS

The theory requires, we have said, that there be this difference in fecundity. But do facts back up the theory? We have reached a point in the study of evolution where we are tired of theories. We want facts.

Sometimes we can get them; sometimes we can not. In this particular case a study of long-lived people gives us exactly the information that we needed and expected. As we have seen, the long-lived—who must be considered to be in generally an unusually *fit* lot of people—are found to have more offspring than the shorter-lived and less fit. And since this fitness is, as we know, hereditary, it follows that the race should be getting a little more fit in this respect, with each generation, because the amount of inherited longevity must be greater than it was in the previous generation.

The lonesome and fatherly Mr. Davis, cited in a newspaper story at the beginning of this article, may or may not exist in real life. But if he does not, it would not be difficult to find some one else conforming to the same specifications; for long life *does* mean a large family. We have been able to measure the exact amount of association between the two facts, and thus add another piece of mathematically demonstrated proof to the theory of evolution which Darwin left us.

Modes of Research in Genetics

MODES OF RESEARCH IN GENETICS, by Raymond Pearl, Biologist of the Maine Agricultural Experiment Station. Pp. 182, price $1.25. New York, the Macmillan Company, 66 Fifth Avenue, 1915.

The principal and most useful part of Dr. Pearl's book is a discussion of the relative merits of the two principal methods used in studying heredity—namely, the biometric and the Mendelian. Public opinion is still confused as to the respective spheres of these methods, as a result of the conflict between them which raged a few years ago. Advanced students now generally recognize that each of these methods has its place, and also its limitations; but the beginner, who frequently reads the literature of a decade ago, is too often confused by the recriminations and denunciations he finds. Dr. Pearl shows clearly just what each method can do, the biometric method being essentially the study of the ancestry of an individual, while the Mendelian method is the study of the posterity of an individual. A perusal of this book will do much to clear up the ideas of a great majority of those who are actively interested in genetics. The problem of inbreeding, and the general relation between practical breeding and experimental genetics, are also discussed.

Journal of Heredity As Text-book

The class in heredity at the Ohio State University is now using the JOURNAL OF HEREDITY as its text-book, arrangements having been made for a special short-term membership in the American Genetic Association, for each of the twenty-two students taking the course.

INCREASING FECUNDITY

Remarkable Effect of Pituitary Substance on Poultry May Have Wide Application—Great Increase in Egg Production and Hatchability of Eggs Obtained

FECUNDITY is one of the most important factors in the practical application of genetics, whether it be in eugenics or animal-breeding.

Any method of increasing the fecundity of valuable strains would be of great worth to the eugenist and the breeder.

One such method seems to have been found by Lewis Neilson Clark, of Oldham Farm, Port Hope, Ontario, Canada, a member of this association who has been experimenting with the ductless glands of animals, by feeding extracts of them to chickens. By the use of an extract of the pituitary gland, he has increased the egg production of hens, sometimes nearly doubling it, and at the same time has secured an increased "hatchability" of the eggs.

The pituitary gland of calves, secured by Mr. Clark from his local butcher, is a small rounded body attached to the under side of the brain, and consisting of two lobes, an anterior and a posterior. It is generally supposed to regulate, by its secretions, the nutrition of bone and other connective tissue, and to have many other far-reaching influences on the entire body. For the experiment here described, Mr. Clark used only the anterior lobe of the gland, which he ground up and mixed with sugar of milk to form a paste. This paste was dried at room temperature, ground to a powder, and weighed, the loss in weight amounting to 13.5 per cent. In the experiments recorded below 69 milligrams of this powder, representing 20 milligrams of fresh pituitary substance (anterior lobe), were administered to each hen per day.

RECORD OF HENS KNOWN

"The first experiment attempted," Mr. Clark writes,[1] "dealt with thirty-five Single Comb White Leghorn hens hatched in April, 1913, mated, in two pens, to two cockerels of the same breed, hatched in May, 1914. These two pens were housed in two colony-houses, on free range, and had been used as breeding-pens for this season's work before the dosing was commenced. I have, therefore, records of their egg production for several months previous, the laying being very steady and consistent. For the purpose of illustrating the results of this experiment, it will be necessary to give only the egg production for a period of fourteen days prior to first dosing. It will be noted in Table I[2] that the production curve was declining, previous to dosing, this being only natural in view of the heavy and consistent laying of these hens since February. Both hens and cockerels were forcibly fed at night time with the powder, enclosed in gelatin capsules, the dose in each case being 69 milligrams. The first dose was given on the evening of May 20 and the last dose on the evening of May 28. A remarkable increase in production

[1] The Effect of Pituitary Substance on the Egg Production of the Domestic Fowl. By Lewis Neilson Clark. *Journal of Biological Chemistry*, Vol. XXII, No. 3, pp. 485-491; October, 1915.

[2] The table is too long to be reprinted here. A summary is as follows:

First dose evening of May 20. Last dose evening of May 28.

Average daily egg production of experimental pens May 7 to May 14, inclusive, 19.25 eggs=55 per cent possible.

Average production May 15 to May 23, inclusive (to 3 days after first dose), 16.11 eggs=46 per cent possible.

Average production May 24 to May 30, inclusive (from 3 days after first dose to 2 days after last dose), 32 eggs=91.43 per cent possible.

Average production May 31 to June 6, inclusive, 21.57 eggs=61.63 per cent possible. The pens were broken up on June 7.

was noted on the fourth day after the administration of the first dose, but was apparently dropping back to normal when, owing to the exigencies of the management of a large poultry farm, it was necessary to break up these isolated pens. The hens were kept under close observation for a period of one month after the last dosing and their general health continued exceptionally good, there being not one case of sickness or death among any of the subjects, and the general appearance of the birds being far above the average for this season of the year.

A CHECK ON THE RESULTS

"I felt sure that the marked increase shown in the production of these hens, whose laying had been most consistent and whose production curve was on the decline at the time of experiment, was due solely to a direct stimulating effect on the ovaries, produced by pituitary substance, and to no other causes. A 100 per cent egg production is almost unknown in my experience, at this season of the year, especially with flocks of this size (seventeen and eighteen in a pen). The conditions for egg production were practically ideal, but the same conditions, and very much the same weather, had obtained for a month previous. In order to meet the natural query as to whether the weather or other conditions might not have influenced the production of the experimental fowl, the daily egg records of two large laying pens were studied and are given in Table I for comparison.[3] Conditions in these two pens and in the experimental pens were very similar. Feeding conditions, weather, and the nature of the soil were identical, the only difference being in the fact that the experimental pens were in small isolated houses, on free range, whereas the large flocks were in long continuous laying-houses each with a fenced-in run of three and one-half acres of land.

"In order to test the effect, if any, on the hatchability of the eggs and the viability of the chicks, 100 eggs from the experimental fowl were collected previous to dosing—that is, from May 14 to May 20—and were set in an incubator on May 20, the eggs being from two hours to six days old. On the fifth day after the first dose, eggs were again collected from the same fowl, 100 eggs being gathered from May 26 to May 28, and were set in an incubator of the same make on May 29, the eggs being one to three days old. The results of these hatches are even more remarkable than the increased egg production, as is seen from Table II.[4] Prairie State Sand Tray Incubators of the same size were used. Conditions of temperature were closely regulated by thermostats. In both experiments the temperature ranged from 102–103.5° F., as required to give the best conditions for hatching. The chicks are being kept under observation to note sex and any peculiarities of growth.

TEST ON LARGER SCALE

"Feeling it desirable to have a further experiment to more fully prove the effect of this substance, I determined to dose all the hens in one of the large laying-houses. The house so chosen contained 655 one-year-old Single Comb White Leghorn hens (no males), and the dose administered to them was 45 grams of the powder per day. Owing to the large scale on which the experiment was being conducted, it was only possible to obtain sufficient material for four daily doses. It was unfortunate that the dosing could not be continued over a longer period, but the results obtained from these few doses were so marked and striking as to leave no doubt as to the stimulating effect of

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[3] For the corresponding periods, the laying record of a flock of 657 hens was as follows:
May 7 to May 14, inclusive, 45 per cent possible.
May 15 to May 23, inclusive, 45 per cent possible.
May 24 to May 30, inclusive, 44 per cent possible.
May 31 to June 6, inclusive, 44 per cent possible.

[4] Of the 100 eggs set before dosing, 6 were infertile and 8 showed dead germs; 15 chicks died in shell (7 pipped); 71 hatched.
Of the 100 eggs collected after dosing, 0 were infertile, 0 showed dead germs, 4 died in shell (all pipped), 96 hatched.

the pituitary substance (anterior lobe) on the egg production of the domestic fowl.

"As will be noted in Table III,[5] in the preliminary period, the production curve of these 655 hens was again, in this case, on the decline. In order to show that weather or other conditions did not apparently tend to increase production on these dates, I have again given (in Table III) the daily egg record of the flock of 431 hens. It will be noted in this case that the stimulating effect on the 655 hens lasted only about seven or eight days after the last dosing, but it will be seen that the total dose administered only provided, during the four days, the equivalent of 80 mg. of pituitary substance per hen and there is no assurance that the material was equally divided among the hens. It being impracticable to forcibly feed so many hens, the following method was employed in this case: 45 grams of powder were divided into three equal parts, each part thoroughly mixed into a pailful of dry mash. This mash was then moistened with sour skim milk and fed to the hens. The same quantity of this same moist mash had been fed to these hens every day for months past. It had been mixed in exactly the same way except for the addition of the pituitary substance, and feeding conditions and general care were identical during the experiment with conditions previous, as far as it is possible to make conditions of this kind identical. It was noted that on the second day after dosing, these hens required, and were given, a larger allowance of grain than previously, and the dry mash being always before them in open feed hoppers, it is probable that they consumed a greater quantity of this material than under normal conditions. The increased appetite was undoubtedly occasioned by the increase in production, the writer having often noted the fact that a sudden increase in the appetite of a flock is usually a precursor of an increase in egg production.

"I am publishing this paper as a preliminary report. Further experiments will follow to determine:

"1. The post period during which the stimulating effect lasts.

"2. The smallest dose producing the desired results.

"3. The general health, growth curve, and age at maturity of chicks from dosed parents.

"4. A comparison of the effect of pituitary substance taken from growing mammals and from adult mammals.

"I have other experiments under way at the present time.

"At the time these two experiments were completed I did not know that work of a similar nature had been done by Pearl and Surface. These two observers administered the pituitary substance hypodermically to hens whose ovaries were in a state of complete rest (at the moulting season). They found no activation, but their experiments were carried out under very different conditions, as regards the physiological condition of the subjects, the method of administering the substance, etc. It seems possible to me that the negative results they obtained as compared with my positive results might be explained by the fact that the pituitary substance I used was from growing mammals while it is probable that their material was from adults, as it was purchased from the Organotherapeutic Laboratory of Armour & Company. It is known from the work of McCord that positive results are obtained from the use of pineal body from growing mammals, and negative results from this substance taken from adults, and the same may be the case with pituitary gland. Experiments are in progress to test this point.

"These experiments show that:

"1. Feeding of pituitary gland sub-

[5] Average daily egg production of fowls:
June 1–8: Experimental pen 45 per cent possible, laying-house 40 per cent.
June 9–17: Experimental pen 38 per cent, laying-house 38 per cent.
June 18–24: Experimental pen 36 per cent, laying-house 36 per cent.
June 25–July 1: Experimental pen 51.78 per cent, laying-house 35 per cent.
July 2–11: Experimental pen 39.14 per cent, laying-house 31 per cent. The first dose was given to the experimental pen on the afternoon of June 21 and the last dose on the afternoon of June 24.

stance (anterior lobe) increased the egg production of hens whose production curve was on the decline: Case 1, with 35 hens in isolated pens; Case 2, with 655 hens.

"2. The dosage was effective on the fourth day after the first dose and lasted for several days after the last dose.

"3. The hatchability of eggs from dosed parents was increased."

Heredity and Criminal Delinquency

Heredity is considered only a minor cause of delinquency by William Healy, director of the Juvenile Psychopathic Institute of Chicago, who presents an analysis of 823 individual cases in his recent book "The Individual Delinquent." Mental abnormalities and peculiarities appear as a main factor 455 times and as a minor factor 135 times; but Dr. Healy apparently does not consider such abnormalities to be the equivalent of bad heredity. "Defects of heredity" are noted in no case as a main factor, but in 502 cases as a minor factor. Other causes listed by Dr. Healy, such as "abnormal physical conditions," "defective home conditions, including alcoholism," would be thought by many students to be largely due to defective heredity; and to heredity, therefore, might well be ascribed a much more important rôle in the production of criminal delinquents, than Dr. Healy gives to it, if one used the same facts but started with a different viewpoint or different definitions.

An Outline of Eugenics

BEING WELL-BORN, by Michael F. Guyer, Professor of Zoology at the University of Wisconsin. Pp. 374, price $1.00. Childhood and Youth Series. Indianapolis, Bobbs-Merrill Company, 1916.

The field of heredity in man is resurveyed by Dr. Guyer in a compact volume which omits few topics of importance. The study of the cell and the mechanism of heredity are given much space, and methods of cutting off defective lines of descent are also dealt with at length. Less attention is given to constructive eugenics than one might wish, but the recommendations made are sound and conservative. A full glossary adds to the value of the volume. In the highly controversial field of Mendelism the author's conclusions will not always be accepted by other students, but this is a detail which detracts little from the general soundness of judgment shown. A comparison of Dr. Guyer's book with those on similar subjects by other authors will convince anyone that there is substantial agreement between those who have studied the problem from various angles, in regard to what eugenics can and cannot do.

Eugenics in Hungary

An organization for Race-Hygiene (Eugenics) exists in Hungary since two years. Instead of founding a new society, existing societies prominent in social and medical work organized a common Committee for Race-Hygiene in Budapest, on February 25, 1914, under the leadership of Count Paul Teleky and Professor Apáthy. There is no special organ for publications as yet, but the Hungarian Sociological Review has a permanent column for topics of Race-Hygiene. The work was started with the government taking much interest in it, when the war broke out and stopped further activities except an action to repress venereal diseases in the army.

G. VON HOFFMAN, Berlin.

PATROGENESIS

A Form of Inheritance with the Characters of the Female Parent Completely Excluded—A Cross Between Two Genera of Grasses, Tripsacum and Euchlaena[1]

G. N. Collins and J. H. Kempton
Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

INTRODUCTION

A FERTILE hybrid between *Tripsacum dactyloides* L. and *Euchlaena mexicana* Schrad., was reported by the writers in 1914. The behavior of the single first generation plant was at that time described and its close resemblance to the male parent noted.[2]

It is now possible to report the behavior of the progeny of this hybrid plant, which have been grown for two seasons, and to make comparisons with the first generation plant and with the parents.

The parental stocks were *Tripsacum dactyloides* and *Euchlaena mexicana*. Tripsacum is a perennial grass native in many parts of eastern United States and is of no economic importance. Euchlaena is an annual grass native in Mexico and frequently grown in the United States for forage under the name of "teosinte." These species not only belong to different genera, but are placed in separate groups of the tribe Maydeae. The two genera, together with Maize or Indian corn, are the only American representatives of the tribe. The plants differ profoundly in general appearance, as well as in structural details, as the illustrations show.

The list of contrasted characters given on the opposite page will serve to indicate the more conspicuous differences.

The plant of Euchlaena used as the male parent in the hybrid was from seed received from Dr. H. V. Jackson, of Durango, Mexico. Euchlaena is reported as a wild plant about Durango. It is also cultivated in the same region. The cultivated form, at least, is much hybridized with maize. Plants representing all stages from what appears to be pure Euchlaena to those that closely resemble pure maize have been grown from original seed received from that region.

The fact that the particular plant used as pollen parent of the cross was grown in the greenhouse, where Euchlaena plants never behave normally, made it difficult to determine whether this plant shared any of the frequent contamination with maize. The plant was stunted and somewhat abnormal, but no maize characters could be observed, and there has been a similar absence of maize-like characters in the pure seed progeny of the hybrid plant. It is, therefore, believed that the male parent of the hybrid represented a relatively pure form of Euchlaena.

DESCRIPTION OF SUPPOSED HYBRID

The original cross was made in March, 1913, in a greenhouse of the Department of Agriculture at Washington, the Euchlaena pollen being placed on the stigmas of a plant of Tripsacum. Precautions were taken to guard against foreign pollen, although no other Tripsacum plants were growing in the greenhouse and no pollen was yet being produced on the plant that was fertilized, Tripsacum being decidedly proterogenous. The cross was such a violent one that there was little expectation of success, but four seeds developed and these were planted as soon as mature. When a sprout appeared above

[1] Read before the twelfth annual meeting of the American Genetic Association, at Berkeley, Cal., August 6, 1915.

[2] Collins, G. N., and Kempton, J. H., A Hybrid between Tripsacum and Euchlaena. *Journal Washington Academy Science*, Volume IV, No. 5, pp. 114-117, March 4, 1914.

TRIPSACUM DACTYLOIDES	DURANGO EUCHLAENA
Plant perennial.	Plants annual.
Staminate and pistillate flowers in the same inflorescence.	Staminate and pistillate flowers in different inflorescences.
Terminal inflorescence with from 1 to 3 branches.	Terminal inflorescence with from 8 to 20 branches.
Branches of terminal inflorescence erect.	Branches of terminal inflorescence drooping.
Branches of terminal inflorescence without pulvini.	Branches of terminal inflorescence with pulvini.
No secondary branches in terminal inflorescence.	Secondary branches in terminal inflorescence equalling or more numerous than the primary.
Staminate spikelets in pairs both sessile.	Staminate spikelets in pairs one sessile, the other pedicelled.
Staminate spikelets in alveolae.	Staminate spikelets not in alveolae.
Pistillate inflorescence naked.	Pistillate inflorescence enclosed in bracts.
Outer glume of pistillate inflorescence completely exposed.	Outer glume of pistillate inflorescence partially enclosed by the rachis.
Stigmas about 2 cm. long.	Stigmas from 10 to 15 cm. long.
Stigmas divided to the base.	Stigmas divided for about 3 mm.
Inflorescence basipetal.	Inflorescence acropetal.
Fruit trapezoidal.	Fruit triangular.
Rachis not constricted between the seeds.	Rachis constricted between the seeds.
No branches in axils of prophylla.	Branches in the axils of prophylla.
Leaf blades about 50 times as long as wide.	Leaf blades about 10 times as long as wide.

the surface of the ground our faith was still so small that the plant was dug up and the seed examined to make sure we were not rearing a "cuckoo." As the sprout was found to be growing from an unmistakable Tripsacum seed, it appeared certain that the plant was either a hybrid or a parthenogenetically developed Tripsacum. The second alternative was soon dismissed, for Euchlaena characters appeared with the first leaves, and the further stages of development were those of a nearly normal Euchlaena plant. Most careful scrutiny failed to disclose any characters that could be referred to Tripsacum, the female parent. The plant was not exactly like others that had been grown previously, but even under the most favorable greenhouse conditions, Euchlaena shows many deviations from the normal behavior. The deviations in this were not extreme or unusual, indeed the plant was more nearly like normal Durango Euchlaena than any Euchlaena we have ever been able to grow under greenhouse conditions.

Two points regarding this cross should be kept in mind: (1) the plant was known to have grown from a seed borne on a Tripsacum plant; (2) the plant resembled the *male* and not the female parent. These two facts taken together eliminate all questions of foreign pollen or faulty technique.

The plant was grown to maturity in the greenhouse, was carefully guarded and self-pollinated and produced a quantity of seed. Unfortunately no Tripsacum pollen was available at the time the first generation plant was in flower, October, 1913, but plants of a Florida Euchlaena were just beginning to shed pollen and this was applied to a number of the pistillate inflorescences. Two very late varieties of tropical corn were also in flower and pollen from them was similarly used. All the pollinations were successful, seed setting as readily with the corn and Euchlaena pollen as with the plant's own pollen.

THE SECOND GENERATION

A few seeds representing each class of pollinations were planted in the greenhouse in December, 1913. From this planting there were secured seven plants, with the following parentage: Three plants from self-pollinated seed of the first generation cross; one plant from the first generation cross pollinated with Florida Euchlaena; two plants of the first generation cross pollinated with a Liberian variety of maize; one plant of the first generation cross pollinated with a variety of maize from Bolivia. The last plant was soon eliminated as the result of a peculiar abnormality. The sheath of the first leaf instead of being open on one side and enclosing

FEMALE PARENT OF THE CROSS

Plant of *Tripsacum dactyloides*, a grass which is fairly common in the southeastern United States. When crossed with the grass shown in the following photograph, it produced seeds, but did not seem to contribute any of its own characters to these seeds. Photograph made at Lanham, Maryland. (Fig. 2.)

the succeeding internodes, was closed and solid, consequently the growth of the plant terminated with the first leaf.

During the early stages the remaining six plants all behaved much as did the first generation plant, the only observable difference being their more early branching and the fact that the branches were nearly prostrate for several months. Studies of Tripsacum seedlings disclosed no such tendency to produce horizontal branches from the lower nodes. Minor differences in the development and distribution of the hairs appeared, but these were not consistent even among the plants having the same male parents.

As the plants developed the diversity became more pronounced, although the variations were largely in the nature of abnormalities. With one exception the main axes of all the plants terminated their growth much earlier than is customary in Durango Euchlaena, only ten to fourteen internodes being produced. The branches from the lower nodes of all these plants greatly exceeded the main stalk in height and produced many more internodes. The exception noted was one of the plants having the Liberian maize for male parent. This plant produced 51 internodes, a larger number than has been recorded in Euchlaena, Tripsacum or maize.

The terminal inflorescence of these six second generation plants varied greatly, but none of the forms showed any approach to Tripsacum. One of the most striking abnormalities consisted in the replacement of the lower spikelets of the terminal inflorescence by little plants.[3] This abnormality occurred in the plant having the Florida Euchlaena for its male parent, in two of the second generation plants obtained by self-fertilization, and to a less extent in one of the plants having the Liberian maize for male parent. Several of these little plants which developed roots while still attached to the parent were removed and potted. They grew into plants resembling the larger branches or suckers of the parent plants and matured seed. Plants from some of the seed thus produced were grown during the past season (1915) and behaved like plants from self-pollinated seed of the second generation plants.

The diversities of the first lot of second generation plants, together with the occurrence of hitherto unobserved abnormalities, led us at that time to believe that although we could detect no indication of Tripsacum characters, the plants were something other than pure Euchlaena.

Further plantings from the original lots of seed secured from the first generation plant were made in the greenhouse in April, 1914. As soon as the weather permitted these were transplanted to the open and still other plantings were made directly in the open soil. We thus had second generation plants maturing in the greenhouse and others in the early stages growing in the open at the same time.

These later plantings, including both those transplanted and those planted in the open, developed none of the abnormalities observed in the first lot grown in the greenhouse. The straight second generation plants appeared to be pure Durango Euchlaena. The others were what might have been expected in first generation hybrids between Durango Euchlaena and the different types of maize used as male parents.

THIRD GENERATION

In the season of 1915 experiments were conducted near San Diego, Cal. The long growing season of Southern California afforded the first opportunity to allow plants of the hybrid to grow to maturity undisturbed. Small plantings were made of such second generation seed as had been obtained and the following plants were secured: ten plants from self-pollinated seed of three second generation plants of the hybrid; seventeen plants from self-pollinated seed of three plants of (Tripsacum x Euchlaena) X Liberian maize; five plants from self-pollinated seed of one plant of (Tripsacum x Euchlaena) X Florida Euchlaena. Plantings of Durango

[3] A similar abnormality has been observed in maize. See Collins, G. N., Apogamy in the Maize Plant. Cont. U. S. Nat. Herb., XII, Pt. 10, pp. 453-455, 1909.

MALE PARENT OF THE CROSS

Plant of Euchlaena, a grass which is grown to some extent for forage in the United States, under the name of teosinte. The variety here represented is that from Durango, Mexico; photographed at San Diego, Cal. In a cross with the grass shown in the preceding photograph, this Euchlaena proved so prepotent that the offspring cannot be distinguished from the male parent; while the female parent seems to have exerted no influence whatever on the heredity. This unusual type of heredity has been given the name of patrogenesis. (Fig. 3.)

THE HYBRID RESEMBLES THE MALE PARENT

Compare this plant with the one shown in the preceding illustration, and you will see no real difference. Yet this is a hybrid, in the first generation from the Tripsacum x Euchlaena cross. The identity between the male parent and the offspring is so close that the female parent seems to have done nothing but furnish nourishment for the development of the seed. (Fig. 4.)

FLOWERS OF THE TRIPSACUM

The hairy threads in the lower part of the picture are the pistillate or female flowers, while above are the male or staminate flowers, their dark-colored anthers or pollen sacs hanging on very fine filaments. Photograph natural size. (Fig. 5.)

Euchlaena were also made for comparison. The seed was planted on March 16, and a second planting of Durango Euchlaena was made on June 11. The third generation plants of the cross, with the exception of those that had been crossed with maize, all developed as normal Durango Euchlaena, free from any of the abnormalities observed in the second generation plants grown in the greenhouse. Early in the season the branches showed the prostrate habit characteristic of the first and second generation plants, but the Durango Euchlaena plants also showed the same habit. Curiously enough, the first planting of Durango Euchlaena developed a series of abnormalities almost exactly paralleling those of the second generation hybrid plants grown in the greenhouse. Of eighteen Durango Euchlaena plants, twelve produced aborted main stalks that matured with nine to thirteen leaves. Four of the eighteen plants produced apogamous plants in the place of spikelets. All of the abnormal plants produced numerous suckers that grew normally and were indistinguishable from the main stalks of normal Durango Euchlaena plants. The later planting of Durango Euchlaena was entirely free from these abnormalities.

Table 1 gives the average measurements of plants grown at San Diego. It can be seen that there are no striking differences between the hybrid plants and the Durango Euchlaena, the hybrid plants being in many particulars intermediate between the two plantings of Euchlaena. Where significant differences occur they are not of a nature to suggest Tripsacum.

Several hundred plants from open pollinated seed of the different second generation hybrid plants were also grown and carefully examined for indications of Tripsacum, but no characters or abnormalities not attributable to Euchlaena or maize were observed.

TRIPSACUM POLLINATED BY MAIZE.

To repeat the original cross in the late plantings has been impossible, through a failure to bring Euchlaena and Tripsacum into flower at the same time. In 1914, however, maize pollen of several varieties was available at the time the Tripsacum plants were in flower. Numerous attempts to fertilize Tripsacum flowers with maize pollen resulted in a small quantity of viable seed. A number of plants from these seeds have been grown, but instead of resembling the male parent, all are apparently pure Tripsacum. These crosses were made with such precautions against accidental pollinations and have been secured in such numbers that there can be little doubt regarding the parentage of the plants. Euchlaena and maize are so nearly related and have behaved so much alike in the perjugate generations of our original cross with Tripsacum that we fully expect to secure similar results

TABLE 1.—COMPARISON OF TWO PLANTINGS OF DURANGO EUCHLAENA WITH TRIPSACUM X DURANGO EUCHLAENA, GROWN AT CHULA VISTA, CAL., 1915

	Durango Euchlaena planted March 16	*Durango Euchlaena planted June 11*	*Tripsacum X Euchlaena third generation*
Height in centimeters	313.0± 8.25	202.0±5.51	200.0± 8.15
Exsertion of tassel in centimeters	6.6± .94	3.0± .48	1.7± .59
Branching space in centimeters	7.9± .45	11.1± .52	10.1± .31
Length of central spike in centimeters	13.8± .84	10.6± .44	8.2± .23
Length of lowest tassel branch in centimeters	17.5± .64	15.8± .72	11.0± .56
No. branches	10.1± .37	13.8± .64	12.3± .42
No. secondaries	16.0± 1.71	29.2± .36	27.2± 1.35
Length of longest leaf in centimeters	80.3± 2.01	67.8±1.47	67.7± .87
Width of longest leaf in centimeters	4.2± .13	6.0± .20	4.0± .08
Nodes above longest leaf	9.6± .19	8.8± .39	10.3± .66
No. suckers	18.8± 1.48	8.1± .76	11.0± .95
Height of tallest sucker in centimeters	300.0±10.10	195.0±2.79	199.0±10.90
No. exserted internodes	6.9± .26	7.7± .39	4.7± .37
Diameter of stalk in centimeters	2.2± .57	2.8±1.27	3.2± .59

THE MALE PARENT AND THE HYBRID: FLOWERS

At the left are pistillate flowers of the Durango Euchlaena, while on the right are shown pistillate flowers of the cross between Euchlaena and Tripsacum. They are alike in almost every particular, and the flowers of the hybrid shown no influence of the parent—compare with fig. 5. Photographs natural size. (Fig. 6.)

THE MALE PARENT AND THE HYBRID: FRUITS

Below are fruits of the Durango Euchlaena, nearly mature, and shown natural size. The spikes are arranged as they were borne on the branch. Above are the mature fruits of the Euchlaena x Tripsacum hybrid, likewise arranged as they were borne on the branch, and photographed natural size. The fruits of the male parent and hybrid offspring are similar in every respect. (Fig 7.)

MALE FLOWERS OF THE EUCHLAENA

They are much like the familiar "tassels" of maize, to which the Euchlaena is closely related. But they are also so much like the staminate flowers of the Euchlaena x Tripsacum hybrid, shown in the next photograph, that no one could tell the difference. Photograph natural size. (Fig. 8.)

MALE FLOWERS OF THE HYBRID

There is nothing in this inflorescence which resembles the flowers of the mother (Tripsacum), shown in Fig. 5. But every detail resembles the corresponding detail of the male flowers of the paternal parent (Euchlaena), shown in the preceding illustration (Fig. 8). This similarity with the male parent, and exclusion of all the characteristics of the female parent, appear in all the traits of the hybrids, and have led to the belief that we are here dealing with a new type of inheritance, which has received the name of patrogenesis. Photograph natural size. (Fig. 9.)

with Euchlaena pollen. It appears, therefore, that the complete resemblance to the male parent, which we secured in the first cross, was exceptional. Crosses between Tripsacum and Zea, at least, usually show a complete resemblance to the female parent. It seems not improbable that the maize pollen served only to induce parthenogenesis in the Tripsacum parent. With the view of determining this point material for cytological study has been secured and is being investigated.

CONCLUSIONS

A cross between *Tripsacum dactyloides*, female, and *Euchlaena mexicana*, male, has been carried through three generations without exhibiting any indication of the characters of the female parent. In attempting to explain this complete absence of the characters of the female parent two alternatives may be considered. (1) The characters of the female parent have been completely masked by those of the male, or (2) the male nucleus developed in the ovary to the complete exclusion of the female, representing in a way the counterpart of parthenogenesis. In the three generations of the progeny of this hybrid at least 350 plants have been examined. This and the fact that a great variety of conditions has called forth great variation and induced many abnormalities without evoking any indication of Tripsacum characters has caused the first alternative to be dismissed. If the second alternative be adopted we are compelled to look upon the results of this cross as a special type of inheritance not previously recognized. Hybrids showing a predominance of the characters of the male parent have been described as patroclinous, but in this cross and its successive progenies no trace of the characters of the female parent has been detected. No true hybridization or conjugation between the two nuclei appears to have taken place. For this form of false hybridization the name patrogenesis is proposed. The term patrogenesis would also serve to place the phenomenon in proper contrast with parthenogenesis. This is rendered appropriate by the occurrence of what appears to be true parthenogenesis in Tripsacum, when pollinated with maize.

The Effect of War

WAR AND THE BREED, by David Starr Jordan. Pp. 265, price $1.35 net. Boston, The Beacon Press, 25 Beacon Street, 1915.

Twenty years ago the idea that war was an important factor in changing the inborn nature of the human race was a novel one recognized by few. Dr. Jordan is largely responsible for making this fact seem almost a truism at the present day. In the present book he has explained the thesis with a great wealth of illustration, and in a most readable way, prefacing the main discussion with a short and popular outline of the various methods in which evolution proceeds. The volume therefore makes an interesting elementary treatise on eugenics, and one that from its timeliness ought to have a wide circle of readers.

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FEWER BIRTHS AND DEATHS: WHAT DO THEY MEAN?

Death Rate Falling in Civilized World in Recent Years—Birth Rate Falling Still More Rapidly—Death Rate Cannot Fall Much Farther, but Readjustment of Birth Rate along Eugenic Lines Is Necessary[1]

WALTER F. WILLCOX

Professor of Economics and Statistics, Cornell University,

CERTAIN important changes in death rates are revealed by a diagram showing annual death rates for a populous area through a long series of years. The American districts best satisfying these two conditions are Massachusetts, for which the death rate since 1849 is known, and the old New York City, for which the death rates run back now through more than a century.

The accompanying diagram shows the death rate in each of these areas for each year from the beginning of registration to the present date. (See fig. 10.)

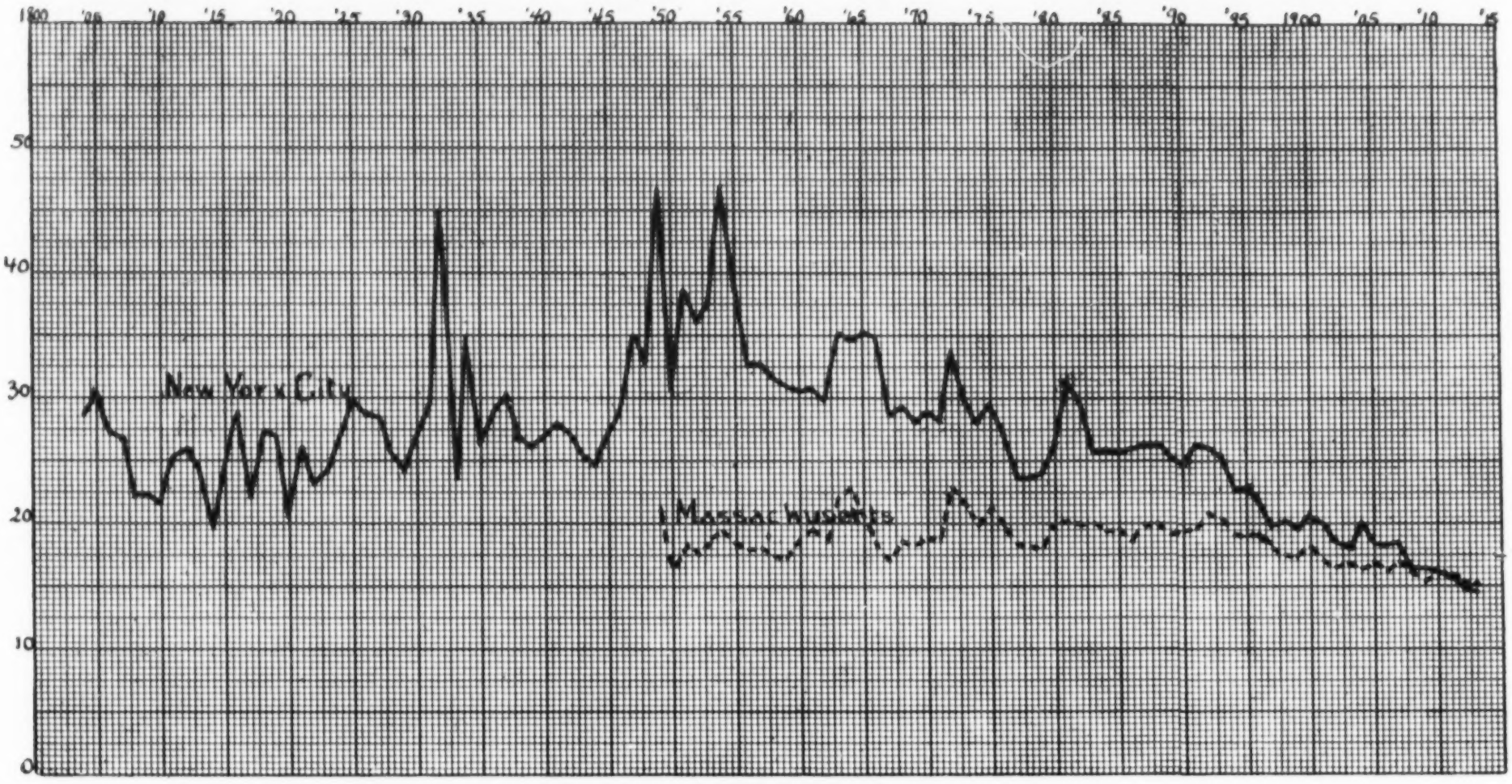
This diagram illustrates what a larger body of evidence would confirm, that the perceptible and steady decline in the death rate is a relatively recent phenomenon. In order to test the correctness of this inference, the average death rate has been computed for each decade and the ratio found between that rate and the rate in the preceding ten years taken as 100. The results are as follows:

	Death rate in		*Ratio of rate to that in preceding decade = 100*	
Date	*New York City*	*Massachusetts*	*New York City*	*Massachusetts*
1804–09	26.3	....	....	....
1810–19	24.7	....	94.2	....
1820–29	25.8	....	104.2	....
1830–39	29.8	....	115.7	....
1840–49	30.3	....	101.5	....
1850–59	35.6	18.0	117.7	....
1860–69	31.7	19.4	89.0	107.8
1870–79	27.6	19.7	87.2	101.6
1880–89	26.8	19.6	97.1	99.6
1890–99	23.1	19.1	86.0	97.1
1900–09	19.0	16.0	82.3	84.0
1910–13	15.3	15.5	80.6	96.7

These figures show that the decennial death rate in New York City rose for the forty years following 1810–19, but has been falling since the Civil War and is now much lower than ever before. In Massachusetts the rate rose until about 1880 and has been falling since that date, but at a slower rate than in New York. Decennial rates for at least two decades have been obtained in twenty-seven European countries and in every one the rate for 1901–10 was lower than for any previous decade. This evidence shows that the decrease of the rate is well-nigh universal in Europe. A few exceptions to the rule, however, are found in other parts of the world; namely, Ontario, Canada, Connecticut, Michigan, Vermont, Chile, Jamaica, Japan and Ceylon. But in some of these the rates at earlier decades were incredibly low and the apparent increase was probably due to more complete returns of deaths in the later years.

The diagram also suggests that the annual fluctuations began to decrease at about the same time that the rates

[1]Paper read by request before Section VIII, Public Health and Medical Science, Second Pan-American Scientific Congress, Washington. D. C.



THE DEATH RATE IS GRADUALLY FALLING

The solid line in this chart represents the death rate in New York City for more than a century, and shows that in spite of annual fluctuations the number of deaths per thousand of the population has been decreasing ever since the middle of the last century. For the last quarter of a century or more there is an almost uninterrupted decline, coincident with the increased attention paid to sanitation and public health. The dotted line shows the death rate for Massachusetts, which also decreased during the last quarter of a century. It is obvious that this decline in death rates can not proceed very much longer. Modern hygiene may postpone the death of a man, but it can not keep him alive forever. (Fig. 10.)

began to fall. To judge whether this is a general or only a local change, conditions in the twenty-three countries of Europe[2] for which the rates as far back as 1870 are known have been examined. The average annual variation has been determined. Naturally the successive years between which the greatest variation occurred were the years of transition from peace to war or *vice versa*. Thus, the greatest changes occurred between 1871 and 1872 and between 1870 and 1871. The war of 1876 exerted a less noteworthy influence. On the whole, the annual fluctuations have decreased but the change is less obvious and uninterrupted than students of individual cities or countries might expect.

Both the steady decrease in the death rate and the slow reduction in the annual fluctuations mark and measure man's progressive emancipation from physical ills of disease or famine, which are closely dependent upon climate and season, and, we might have thought, before August, 1914, from the political ills of war and revolution.

In New York State between 1894 and 1909 there was a marked decrease in mortality during July and August as compared with the average for the entire year. I believe no similar studies have been made for other States. In default of other evidence we may conclude that one factor in the diminishing death rate has been an increased control of deaths in summer. If this should prove to be a general fact, it would probably be connected with the success of efforts to reduce infant mortality. The hot months are especially dangerous to infants, while the cold months are especially dangerous to the aged.

Age influences the death rate more powerfully than any other physiological factor. Most people know that the death rate is lowest at the age of puberty and very much higher at the beginning and end of life. But the amount of

[2] For this purpose the three divisions of Great Britain and Ireland and the eight divisions of the German Empire have been distinguished.

difference is not commonly realized. In New York State boy babies under 1 year of age suffer from a death rate sixty-five times that of boys of 10 to 14. The death rate of nonagenarians rises to 159 times that of the youth.

It would be a natural expectation of one who is told that the death rate is rapidly falling that the gains had been distributed somewhat evenly up and down the scale of years. But this anticipation is not borne out by the facts. Even in a hurried survey like this two points, the possible increase of infant mortality and the possible increase of mortality among the aged, call for mention.

DEATH AMONG INFANTS

High medical authority in England alleged nearly ten years ago that infant mortality is stationary or increasing and this conclusion won some acceptance in the United States. Fortunately the figures proved to be susceptible of another explanation. But into that question there is now no need to go, since even in England and on the face of the figures infant mortality has decreased since 1900. Indeed among the nineteen countries of Europe for which statistics are at hand there is not one in which infant mortality has shown no decrease since the beginning of the twentieth century. In the United States the registration of births is still very defective and there are no large population groups for which we know the true infant mortality, that is, the number of children dying in the first year of life to each thousand living births. Our best substitute for this figure is the ratio between the deaths under 1 year of age and the living children under 1. In the registration States of 1900, comprising 26.3% of the country's population, this ratio fell from 162.4 in 1900 to 141.7 in 1910, indicating that infant mortality fell about one eighth in the decade.

When we turn to the other end of life, the indications of our American figures are less gratifying. In the registration States of 1900 the death rate decreased between 1900 and 1910 for every age period below 55 and increased at nearly every age period above 55. On this point our experience is apparently at variance with that of Europe. The latter indicates that before 1900 the fall in the death rate extended to all ages below 55 and was especially great at ages between 5 and 35, but that for ages above 55 it was slight or absent.[3] The English life tables recently published and speaking for a more recent period show that at every age above 5 years the mortality in 1901-10 was less than that in 1891–1900 and that the mortality in 1910-12 was less than that in 1901-10.[4]

DEATH AMONG THE AGED

The apparent increase of mortality at high ages in our registration States, in opposition to the general trend in other countries, invites and should obtain more careful and thorough analysis than it has thus far received or than I have been able to give it for this paper. Although it appears in both sexes, it does not show itself among women until the age of 60 is reached, while among men over 45 the death rate in 1910 exceeded that in 1900. It appears also among the three classes of native white, foreign born white and colored, earliest among the colored with whom the increase appears in each sex at every age above 30, latest among the foreign born whites with whom the increase does not appear in either sex until the age of 60 and then for females appears only for the ten year age period 60–69. It appears in a prevailingly agricultural State like Vermont at an earlier age and more definitely than it does in a prevailingly industrial State like Massachusetts or Rhode Island. In a recent reference to this change, based mainly upon the figures for Massachusetts and New Jersey between 1880 and 1910, three possible causes were mentioned, "the amalgamation of the various races that constitute our population," "lack of adaptation to our rapidly developing civilization" and "some unknown biologic influence," and a preference for the

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[3] March, *Statistique intern. du Mouvement de la Population*, Vol. I, p. 450.
[4] Reg Gen., *Supplement to 75th Ann. Rep.*, Pt. I, Life Tables, p. 20.

second was indicated.[5] Thus far no evidence has been produced, I believe, showing that the increase is greatest where amalgamation of races is probably affecting the largest proportion of the population or where the lack of adaptation to a developing civilization is greatest.

An influence upon mortality which the United States is in a more favorable position to investigate is that of *race*. Under this term I do not include those residents in the United States who or whose progenitors were born in a certain country or spoke a certain language, like the Scandinavians or the French Canadians. At some future time we may be able to investigate the death rate of groups like those, although the present position and sluggish development of American vital statistics make one fear that the facts may become inaccessible before the country is ready to study them. I refer here to the two great races of white and colored, which include between them more than 99% of our population. The registration States of 1900 contained in that year 19,544,821 whites and 388,198 Negroes and many more in 1910, groups large enough and coming from States widely enough scattered to make the changes in their death rates between 1900 and 1910 somewhat representative of the changes in the whole country.

DEATH AMONG NEGROES

The death rate of whites in these States fell from 17.0 in 1900 to 15.5 in 1910, a decrease of 1.5 per thousand, or 8.8% of the initial rate. Meantime the death rate of Negroes in the same States fell from 25.6 in 1900 to 25.0 in 1910, a decrease of 0.6 per thousand, or 2.4%. These figures show that the fall in the death rate during the decade was more than twice as great among whites as among Negroes. Stating the same change in another way, the death rate among Negroes in these States exceeded that among whites by 51% in 1900 and 61% in 1910.

But to compare the two races in this way and stop without noting whether significant differences exist between the age and sex composition of the two groups might easily lead us into error. Thus among the whites 50.5%, but among the Negroes only 48.3% were male. As the female death rate is lower than the male the true difference between the death rate of the races would probably be greater than the foregoing figures indicate. Even more important is the fact that of the whites 21.5%, but of the Negroes only 16.1% are either children under 5 or aged (55+) and have the high death rate characteristic of infancy and old age.

Probably the best way to measure the effect of these differences in sex and age composition is to compute standardized death rates for each race. When the death rates of each race for a given sex and age are applied to the population of the same sex and age in a standard million distributed as in the registration States of 1900, the standardized death rate in 1910 is found to be 15.5 for whites and 27.5 instead of 25.0 for Negroes, showing that the corrected death rate of Negroes exceeds that of whites by 12.0 per 1,000, or 78%, instead of 9.5 per 1,000, the difference of the crude rates. The corresponding standardized death rates in 1900 were 16.9 for whites instead of 17.0 and 29.0 for Negroes instead of 25.6, showing a fall during the decade of 1.4 per 1,000 for whites and 1.5 per 1,000 for Negroes. But in 1900 the standardized Negro death rate exceeded that of the whites by 72% as compared with 78% in 1910. The standardized death rate among female Negroes exceeds that among female whites by 61% in 1900 and by 72% in 1910, while the difference among males was 69% in 1900 and 84% in 1910, showing that the difference between the males of the two races is greater and increasing more rapidly than among the females. The death rate of each race is falling, but the gap separating the two races has seemingly grown wider. Before the Civil War, according to what evidence we have, the death rate of Negroes exceeded that of whites by 29.8% of the lower rate, and

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[5] Fisher and Fisk, *How to Live*, p. 282. See also Lewinski-Corwin in *New York Times, Magazine Supplement*, December 19, 1915.

in 1890 the difference was 56.5%. These earlier rates are not strictly comparable with each other or with those for 1900 and 1910, partly because they speak for different areas, neither of which agrees with the registration States of 1900, and partly because in them no attempt has been made to allow for differences in the age and sex composition of the two races or for changes in these respects. The general conclusions, however, that the death rate of each race has fallen by approximately the same amount and that the ratio by which the Negro rate exceeds the white has been rising, seem to be supported by evidence enough to make them deserve acceptance.

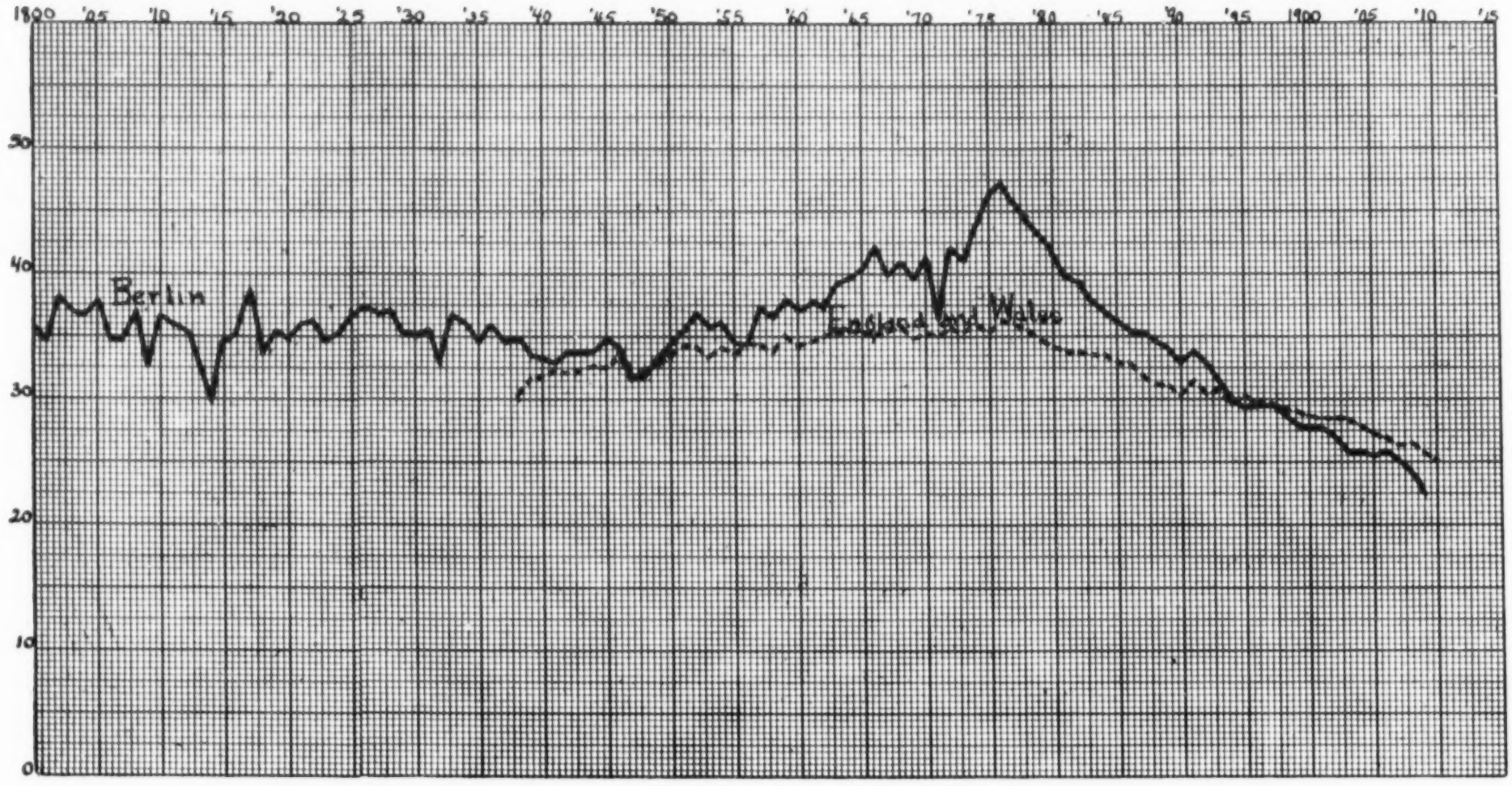
MARRIAGE AND LONG LIFE

Still another influence upon mortality which has been recently investigated is that of *marital condition*. European figures indicated long ago that the mortality of husbands is much less than that of bachelors or widowers of the same age and the conclusion is now corroborated by figures for New York State. No doubt this difference is largely due to the selective process by which the men who marry are, on the average, at the time of marriage more healthy and vigorous than men of the same age who do not marry. Evidence that direct benefits to health accrue from married life is found in the death rate of widowers, which is much higher than that of husbands; in the death rate of Catholic celibate clergy, which is higher than that of Protestant clergy, most of whom are married; and in the death rate of all males during the years at which marriage is most common. The normal and usual course of mortality in each sex is for a slow but steady increase to begin just after the minimum is reached in the early teens, and to continue with accelerating rapidity to the end of life. To this course there is no significant exception among women, but among men in several countries the increase is checked or even turned into a slight decrease for a longer or shorter period between the ages of 20 and 35 when marriage is most common. The probable explanation is that the normal increase of mortality during these years is nearly or quite neutralized by the steady transfer of many men from the less healthy bachelor state to the more healthy married state. The explanation finds some support in the fact that during these years the death rate of bachelors and of husbands treated separately rises steadily with age. On the whole, the evidence justifies the inference that marriage exerts a directly beneficial influence on men's health and prospects of longevity. For wives the facts are less favorable. In New York the death rate of wives between 20 and 29 is greater than that of single women at the same age period. The difference is slight and part of it no doubt is due to the fact that wives 20 to 29 years of age are, on the average, more than two years older than spinsters belonging to the same age group. But as less than half the difference can be thus explained, it seems clear that in New York, as in most other areas in which the facts have been determined, during the early years of married life wives have a higher death rate than spinsters and probably that the difference is largely due to the dangers attending childbirth, especially among those bearing a first child.

THE BIRTH RATES

There are no American birth rates which extend over a long series of years and may be trusted as accurate. In default of evidence from this country I have used in the diagram the birth rates for England and Wales since 1838 and for Berlin since the beginning of the last century. (See Fig. 11.)

The diagram shows that the birth rate was probably at its maximum about 1875 and has decreased almost steadily since that date, that the decrease in England has been about one-third and in Berlin about one-half of the maximum amount, that the variations both from year to year and through longer periods were greater in the city than in the entire state, that the decrease since 1876 has been almost uninterrupted, that there was a marked depression in both areas in 1890, and that Berlin had a much more notable depression in 1871. If in



THE FALLING BIRTH RATE IN BERLIN AND ENGLAND

Formerly the fluctuations in the annual birth rate seemed to depend on natural conditions, but for the last generation there has been a steady fall which is generally ascribed to artificial conditions. Although its causes are many, the principal one is believed to be that married people are gradually learning how to avoid having children. Up to a certain point, this decline in the birth rate was a natural result of the decline in the death rate. Otherwise population would probably have increased faster than wealth. But if it goes any farther, the results to the race may be serious. (Fig. 11.)

the earlier diagram we had used the death rates for Berlin, high points on that curve would have been revealed in 1871 and 1890 when the birth rates were low.

As a rule influences which tend to increase deaths tend also to decrease births, and influences which tend to decrease deaths tend to increase births. This appears even in the rhythm of each day, Italian figures apparently showing that deaths are most frequent and births least frequent in the afternoon. There is also a yearly as well as a daily rhythm traceable in the figures but in this case the reciprocal relationship is between conception as mirrored in the births nine months later and deaths. There is some evidence that during the late spring and early summer and again during the late fall the death rate is low and the conception rate high. There is some evidence, likewise, that during the late winter and the late summer the death rate is high and the conception rate low. This reciprocal relationship between births or conceptions and deaths appears also in the case of any great social calamity. As a war or a pestilence raises the death rate, so likewise it depresses the birth rate, and in estimating the social effect of either it is of the first importance to consider not only the deaths it has caused but also the births it has prevented. For example, in Massachusetts between 1860 and 1864 the death rate rose from 18.7 to 22.8, an increase of 4.1 per 1,000, and the birth rate fell from 29.3 to 24.2, a decrease of 5.1 per 1,000. In Sweden continuous and trustworthy records of births and deaths have been maintained without a break since 1749, a longer period than in any other country. The year 1773 was marked by the heaviest death rate of this century and two-thirds and during that year the birth rate was also lower than in any year before or since. The most universal and fatal epidemic which has afflicted civilized countries of recent years was probably the first of the recent visitations of influenza, which spread over Europe and America in the winter of 1889–90 and caused in New York State about 5,000 deaths. Wherever the births were reported and published by months one finds, nine

months after the influenza epidemic was at its height, a marked shortage of births. There were at least 200,000 fewer births in Europe in 1890 than the average annual number for the preceding five year period.

THE CHANGE OF TENDENCIES

Now the most marked change in the birth rate during the last half century, a change revealed by a comparison between the two diagrams, has been the gradual decline and almost complete disappearance of this reciprocal relationship between births and deaths and the appearance in its place of a tendency for births and deaths to change in the same way rather than in opposite ways. Before proceeding to consider the causes, let me set forth the facts a little more fully.

1. The birth rate and death rate now remain approximately the same in any given country during any few years. The sharp annual variations which characterized these rates and which are still traceable in the statistics of undeveloped countries are disappearing.

2. The tendency of both death rates and birth rates is to undergo large and important modifications in longer periods of time. The sharp up or down movements in both curves connected with such causes as war, pestilence or famine on the one hand, or bountiful harvests and cheap food on the other, are being succeeded by a steady progressive downward movement in the death rate and the birth rate.

Regarding the birth rate in the United States we know practically nothing. But in default of this information I have found an available substitute by comparing the number of children under five years of age at the date of each census with the number of women 16–44 years of age at the same census. The results are given in the following table, in which the figures before 1850 are estimated from such data regarding sex and age as the earlier censuses afford.

During the sixty years 1850–1910 the proportion of children to 1,000 women of child-bearing age decreased in the United States by 191, or an average of thirty-two in each decade. There are only about seven-tenths as large a proportion of children in the United States now as there were in 1850. If we assume that the change will continue in the direction in which it has been moving ever since 1860 and at this average rate of thirty-two in a decade, the number of children under 5 in the country to each 1,000 women 16–44 will be as follows:

Date	*Children under 5 years of age to women 16–44[6] years of age*
1800	976
1810	976
1820	928
1830	877
1840	835
1850	699
1860	714
1870	649
1880	635
1890	554
1900	541
1910	508

1920	476
1930	444
1940	412
1950	380
2000	220
2050	60
2060	28
2070	0

The figures indicate that, if changes like those which have been in progress in the United States since 1850 were to continue unchecked for a century and a half there would be no children left. Let me not be understood as predicting a continuance of the movement for any long period in the future. But often the best method of bringing home to ourselves the vast sweep and significance of the changes revealed by statistics is to project them into the future and see whither they lead. No doubt social movements do not occur along straight lines. On the contrary sharp inflections in the curves of social change are frequent. But it is one of the main duties of statistics to point out the trend of the stream along which society is moving and thus perhaps to arouse a desire for a change.

This tendency to a decline in the

[6] In order to reduce estimates to a minimum in the earlier decades ages 16–44 were chosen instead of 15–49, the more usual limits.

birth rate is in nowise confined to the United States. On the contrary the movement in most European countries has been in the same direction. In twenty-four European countries, all, except Ireland, Portugal and Bulgaria, for which the records are at hand, the birth rate 1901–10 was lower than in the preceding decade and in nearly all of them it was lower than in any earlier decade.

In considering the *causes* of this great change, let me refer first to the position of Herbert Spencer. He has argued that the various organs of the body compete with each other for nourishment and growth, that the surplus not required by the individual is all that can be devoted to the continuance of the race, that no other system makes demands upon the body as heavy as those of the nervous system, that civilization and education are steadily increasing this drain and decreasing the surplus. He finds, therefore, a natural and inevitable connection of a physiological kind between an advancing civilization and a decreasing birth rate. Some students of American statistics have sought to find support for this position in our fragmentary and elusive material. I cannot go farther with the question this morning than to express my judgment that these efforts have not been successful and that there is no conclusive evidence, statistical or otherwise, in support of Spencer's contention. While admitting the heavy and increasing demands upon the nervous system made by modern conditions, I would point out that the decreased death rate and the decrease of sickness by which it is probably attended mean an increase of human vitality and so of the surplus to be drawn upon. Whether the increased expenditure on the nervous system equals or exceeds this increased surplus no one has even tried to prove. Until that is done I believe the Spencerian theory must be deemed only a theory.

THE "RACIAL POISONS"

Nor can we admit, as others have argued, that the decreased birth rate in civilized countries is due either to the growing abuse of alcohol or to the spread of venereal disease. Such arguments have come mainly from special students of these social evils and such students often lose the sense of proportion and find a relief from every social ill in the one reform on which their eyes are riveted.

Walker explained the decrease in the American birth rate by the menace to the American standard of life from the influx of swarms of immigrants accustomed to cheap food and clothing and bad housing and to the effect of this menace upon the birth rate primarily of the native stock and ultimately of the entire population. This explanation is improbable, because the decrease as we have seen began as early as 1810, when immigration was an unimportant influence, and has been matched in Australia, where it must be due to other causes than that assigned by Walker, since Australia has had no great influx of immigrants.

Turning from these inadequate explanations, the true reason for the fall in the birth rate is that in modern times, mainly within the last half century, births and the birth rate have come under the control of human will and choice in a sense and to a degree never before true. Our leading American authority, Dr. John Shaw Billings, put it as follows: "The most important factor in the change is the deliberate and voluntary avoidance or prevention of child-bearing on the part of a steadily increasing number of married people who prefer to have but few children." Before this change began the birth of a child was, to be sure, the result of normal physiological processes, but in the vast majority of cases the birth itself did not indicate a deliberate preference for that result on the part of both or either of the parents. There is not a single one among the experts who denies that this is the great underlying cause of the modern decline in the birth rate of all civilized countries.

FEWER BIRTHS NECESSARY

In considering this change may I first suggest that some such change was an almost necessary consequence

of the great decline in the death rate? That is, if the death rate in Europe had declined as rapidly as it has and the birth rate had not declined, the population of that continent would now be increasing even faster than the wealth or the food supply. The standard of living would be sinking and we would probably soon relapse into our former ill state. It is the decline in the birth rate, and that only, which has enabled mankind to grip and hold fast the advantages promised by the decline in the death rate.

But there is a very important difference between the two changes. It is probably to the interest of society in the long run that each individual should be given a chance to live out his life to old age, and social effort directed to that end is beneficial both to the individual and to society. Thus far the interests of the two coincide. For this reason the two have cooperated and are cooperating effectively to reduce the death rate. But in the matter of the birth rate there is a lack of adjustment between the interests of society and those of the individual. Society is deeply concerned that enough children should be born to secure its own permanence and a reasonable increase and that those children should have the highest promise of service. The individual is deeply concerned not to compromise his own future by assuming responsibility for wife or family without the prospect of being able to maintain them in accordance with his standard of living. The individual may often see for himself or herself, therefore, a balance of advantage in abstinence from or postponement of marriage, in a childless marriage or a small family, while society from its point of view might conceive it to be most important that a given endowment of much social worth should be perpetuated.

If there were time it would be easy to show that a low and diminishing birth rate is especially characteristic of many strains of population, like college graduates of both sexes and the native American stock of the New England States, strains perhaps better endowed than the average population with hereditary qualities the perpetuation of which is socially desirable.

SIGNIFICANCE OF EUGENICS

While persons engaged in grappling with public health problems should interest themselves in the various changes I have briefly outlined, the main question which my figures raise is this, How shall the desirable natural increase of the population be secured and at the same time the quality of the population be maintained or improved by securing at least a normal or average and, if possible, a more than normal birth rate and natural increase in the strains of population which are of the best stock and therefore likely to transmit qualities of greatest social worth?

In this difficult field a few general principles may be stated dogmatically, which I would be glad to explain and defend, if there were time.

1. The death rate cannot be expected to fall much below where it now stands in healthy districts.

2. There is no such natural limit to a fall in the birth rate.

3. The spread in the volitional control of the birth rate is a change against which, even if we believe it undesirable, it is hopeless to struggle.

4. Legal regulations of marriage in the effort to diminish the number of births of diseased or otherwise undesirable children seem likely, unless accompanied by segregation, to do more harm than good.

5. The social service rendered by parents who have hereditary qualities of great value and make heavy sacrifices in other directions in order to rear families of normal size or larger is likely in future to be much better appreciated and requited.

6. Persons interested in maintaining the numbers and improving the quality of the population should aim not merely or mainly at a continued reduction of the general death rate but also at the gradual education of public opinion towards a readjustment of the birth rate in various classes which will enable society to gain from its best strains more than it can do under present conditions.

WHAT THE SIZE OF AN EGG MEANS

Current Belief that Small and Large Eggs Are Produced at the Beginning or End of a Hen's Laying Period is Found to Be Wrong—Usually Appear When Hen is Laying Most Heavily and Steadily

D. E. WARNER AND WM. F. KIRKPATRICK

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IT IS believed by some poultrymen and other observers that the very small and very large eggs which hens occasionally lay are the first or last eggs of the hen's laying period. Lewis[1] states that "the extremely small eggs laid by hens during their laying period are common at the beginning or end of the hens' laying period." The JOURNAL OF HEREDITY[2] in a review of some recent work on Xenia in Fowls shows a photograph from the Bureau of Animal Industy, U. S. Department of Agriculture, and states that "eggs of any individual hen tend to become a litt e smaller as she approaches the end of her laying period and the last one, it is generally believed, is likely to be a dwarf."

That this idea is wrong the writers have been able to demonstrate by a study of the abnormal eggs laid by the hens in the third and fourth egg laying contests held at the Connecticut Agricultural College, Storrs, Conn., for the year ending October 30, 1914, and up to June 1, 1915.

The number of eggs laid by the 1,820 hens during the 20 months' period was 199,137 of which 103 were small (less than .09 of a pound) and 89 were large (over .179 of a pound). The small and large eggs had been credited to the hens that laid them and the weights of the individual eggs also had been taken. The 103 small eggs were laid by only 85 hens, showing that only a small percentage of the hens laid a small egg during their first year of laying. Four hens out of the 85 laid two small eggs at different periods of their productivity. One hen, No. 900, laid fourteen small eggs at different periods and did not have a single normal egg to her credit when she was removed from the pen. This is an exceptional case and further studies are under way in order to determine the cause.

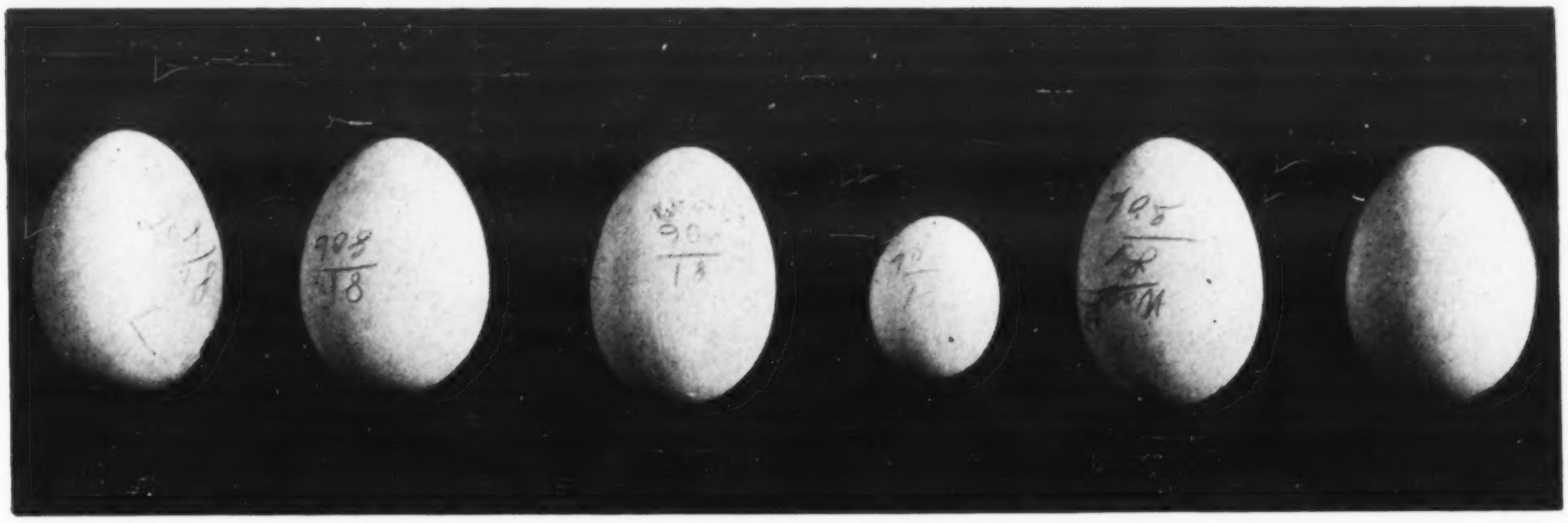
NO REST PERIOD

The first attack on the mass of figures was intended to determine whether a hen usually rested after laying a small egg. It was found that only two eggs out of a total of 103 indicate a resting period[3] after the production of a small egg. In every other case the small egg was found in an almost uninterrupted series of normal eggs. This seems to prove conclusively that small eggs may be laid at any time during a hen's laying period and that most small eggs are laid while hens are at the height of production. Out of the 103 small eggs, 42 show no resting period whatever; in 34 cases the hen rested on the following day, in 13 there was a resting period of 2 days, in 4 cases there was a pause of 3 days, 8 cases show an average period of 6¼ days, and only 2 cases, as noted above, showed a real resting period. But none of these interruptions of the laying is great enough to be considered a real resting period; none of them is greater than is often found with any normal hen during the period of her greatest

[1] Productive Poultry Husbandry, page 306.

[2] JOURNAL OF HEREDITY, Vol. 6, No. 5, May, 1915.

[3] Bulletin No. 82, Connecticut Agricultural College. "The average length of time that a hen rests after becoming broody is about 19.2 days."



A SMALL EGG APPEARS UNEXPECTEDLY

Eggs laid by one hen on six consecutive days are shown in this photograph. They are, with one exception, of average size. The abnormally small egg appears in this series without the slightest warning. The hen has not had any resting period before laying it, nor does she take a resting period afterward. The study of many cases of this sort shows that small eggs are not "pullets' eggs," or the last eggs laid by hens, as is often supposed, but that they usually appear at a time of greatest egg yield, and are probably due to some mechanical interruption in the hen's egg-forming organs. (Fig. 12.)

egg yield, the last two cases excepted, of course.

Having investigated the records of the hens *after* they laid small eggs, it seemed well to inquire what they were doing *before*. Seven records seem to indicate that some small eggs were laid after a hen had had a resting period of from 14 to 25 days. Most of the records show, however, that the small eggs are laid without any previous resting period of the hen.

The figures also showed that as a rule hens do not lay extremely small eggs at the beginning of their laying periods, but that such eggs are laid at a time when the hen is laying most heavily.

It seems clear, therefore, that the small egg is not due to the fact that it is a hen's first attempt, or to the fact that it is the end of her laying period, and represents exhausted power. A fairer assumption as to the cause of these small eggs would be that they are due to some mechanical interference with the hen's normal functions—that they are laid whenever a particle of blood, foreign element, or an undeveloped yolk is drawn into the passage where the shells are formed, and that contractions of the oviduct then cause an egg to be laid completely formed, but without having undergone normal development.

STUDY OF LARGE EGGS

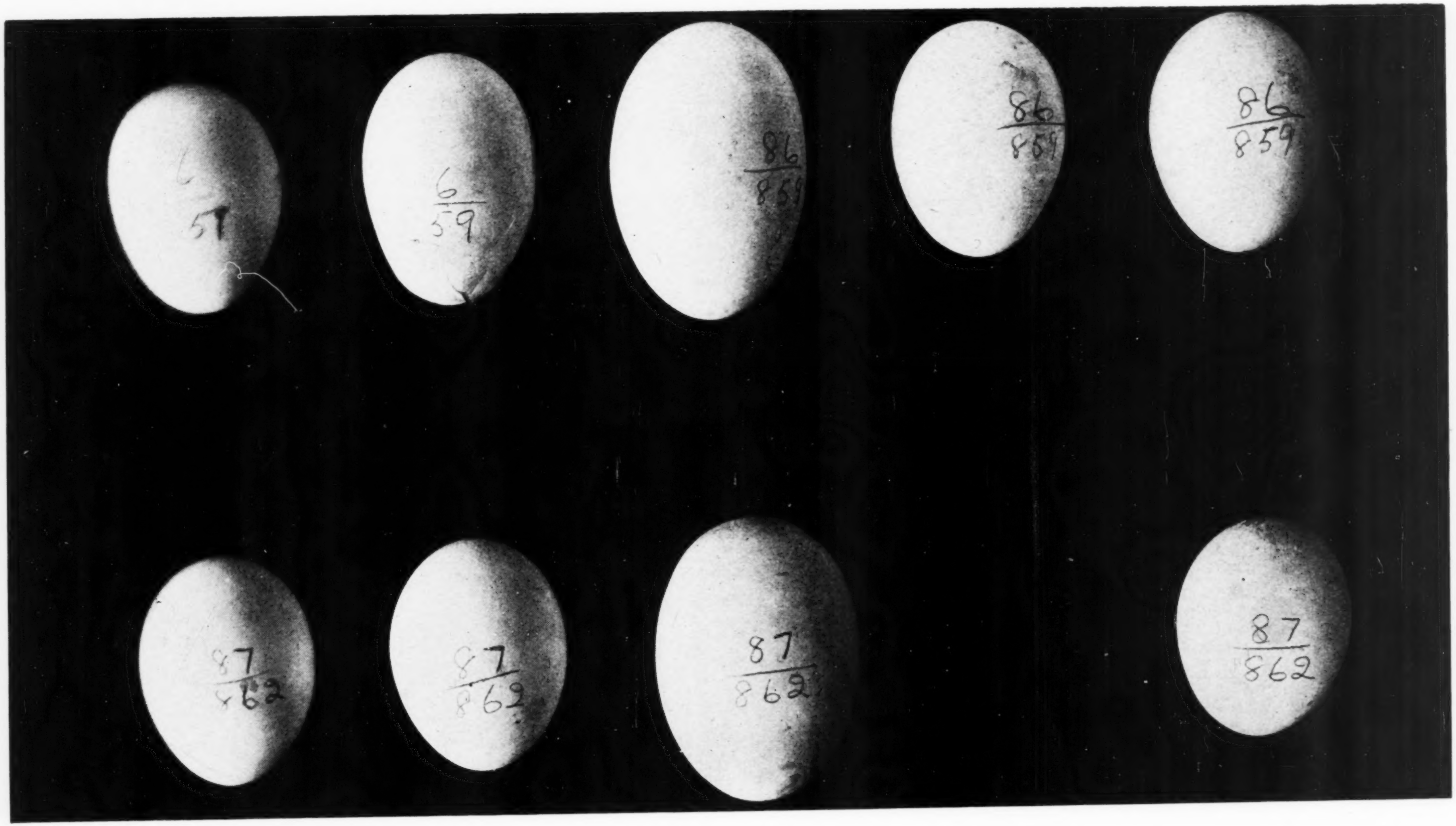
After consideration of the small eggs, the records of production of large eggs were then examined. Eighty-nine were found to have a total weight of 18.35 pounds or an average weight of .206 of a pound.

Of these eighty-nine large eggs, nearly 99 per cent were laid at the time of heavy production, and in most cases the hen did not rest after laying such an egg, but continued her uninterrupted yield of normal eggs.

"The cause of hens laying double-yolked eggs is due no doubt to the simultaneous or almost simultaneous liberation of two yolks and their incorporation in a single set of egg membranes,"[4] or "by the successive discharge of separate follicles at times varying from simultaneous to the normal period and by the subsequent union of the eggs in the duct due to a difference in the rate of passage of the successive eggs."[5]

It further appeared that in most cases the hen did not rest before laying a large egg any more than she did after

[4] Lillie's "Development of the Chick," page 26.
[5] *Journal of Agricultural Research*, Vol. 3, No. 5, February, 1915.



LARGE EGGS COME WITHOUT WARNING

This photograph represents six consecutive days in the egg-laying history of of two hens. They are both laying regularly, and laying eggs of normal size. In the first case (shown above) a large egg suddenly appeared, and then the normal laying was resumed, without the lapse of a single day. In the second case (shown below) the large egg was followed by a rest of a single day; but such breaks in the series occur frequently, with every hen. It appears from the study of such cases as these that a large or double-yolked egg has no special significance in the life of a hen. (Fig. 13.)

such a performance. Forty-five of the large eggs were laid without any previous resting period, thirty-one were laid with a resting period of one day before, and ten were laid with a resting period of two days.

It seems obvious, therefore, that neither small nor large eggs are necessarily laid either at the beginning or end of a hen's laying period, but that they are most often laid during the time of heavy egg production.

TABLE I.—*Weight in Grams of Small Eggs and Weight of Eggs Immediately Preceding and Following.*

No. days.	1	2	3	4	5	6	7	8	9	10	11	12
1911–1912												
Hen No. 263	....	54.4	45.4	....	49.9	**13.6**	49.9	....	54.4	....	49.9	49.9
1912–1913												
Hen No. 126	68.0	....	68.0	63.5	....	**18.1**	....	68.0	63.5	....	63.5	63.5
1913–1914												
Hen No. 629	49.9	....	49.9	49.9	....	**13.6**	49.9	....	54.4	....	54.4	54.4
1914–1915												
Hen No. 806	48.2	48.6	....	47.5	47.5	**27.4**	48.0	48.4	48.6	....	....	48.2

TABLE II.—*Weight in Grams of Large Eggs and Weight of Eggs Immediately Preceding and Following.*

No. days.	1	2	3	4	5	6	7	8	9	10	11	12
1911–1912												
Hen No. 219	58.8	58.9	....	58.9	**86.2**	....	54.4	54.4	....	54.4	54.4	49.9
1912–1913												
Hen No. 144	58.9	....	58.0	....	**90.7**	....	63.5	58.9	58.9	....	58.9	58.9
1914–1915												
Hen No. 862	58.9	....	58.9	58.9	**90.7**	....	54.4	58.9	63.5	58.9	....	63.5
1914–1915												
Hen No. 321	....	70.1	50.4	....	**91.9**	56.4	56.9	56.9	....	50.4	50.1	....

Civilization and Climate

CIVILIZATION AND CLIMATE, by Ellsworth Huntington. Pp. xii + 333, price $2.50 net. Yale University Press, New Haven, Conn.

By experimental tests and an appeal to history, Professor Huntington supports the thesis that a particular kind of climate is necessary to the development of a high civilization and that man is, therefore, more dependent on his environment than he is wont to suppose. The conditions which seem essential to the writer are a fairly high average temperature with moderately large daily fluctuations. This peculiar type of climate prevails today wherever civilization is high, the author thinks; in the past the same type seems to have prevailed wherever a great civilization arose. Therefore such a climate seems to be a necessary condition of great and permanent progress, although by no means the only, or the most important condition—much less a cause. In supporting this thesis, the author is led to an extended discussion of the importance of race, in which he shows admirable poise. The book is unusual, as the presentation of a novel and valuable hypothesis, in a most interesting manner, and with an amount of well-balanced judgment which writers of books like this seldom show.

HEREDITARY NOSE BLEED

Tendency Runs Through Three Generations of a Family—Manifests Itself at Adolescence and Disappears after a Few Years—Possibly Connected with Sex[1]

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SOME years ago I knew two young people who had nose bleed nearly every day, and from no apparent external cause such as injury or exertion. Last spring a third case of this peculiar nose bleeding was found. It so happened that all three of these people were related; and I was told of other cases among their relatives. An inquiry was made and, with the aid of a relative, thirteen cases of this peculiarity were found, all of which are represented on the accompanying chart. Most of the members of this greater family (of which all names will be absolutely withheld) live in neighborhoods where I am acquainted; I know personally most of the individuals represented on the chart and all of those possessing the character in question.

Those individuals who possess the trait have frequent, copious and regular nose bleedings, not apparently arising from such causes as injuries, excitement, exertion, or like factors. These bleedings first manifest themselves, in either sex, at the period of adolescence, and continue until the individual is 18 or 20 years of age. In a few cases the bleeding occurs daily, in other individuals about three times a week. The loss of blood does not seem in any way to incapacitate the subject, save to stop work or play for a moment or two while the blood is flowing.

With but one exception all the individuals who showed this peculiarity were healthy, vigorous, well nourished and developed rapidly after puberty. Indeed, it appeared that those individuals who bled from the nose the most frequently and who lost the most blood showed the greatest activity and developed most rapidly.

Invariably in case the regular nose bleeding did not occur the subject would have headache and a general bodily and mental depression which would be relieved by nose bleeding. In other words, there was a general blood congestion with its accompanying symptoms, which symptoms disappeared after the blood pressure was reduced. In fact, nose bleeding was sometimes purposely induced to obtain relief when the regular bleeding did not occur.

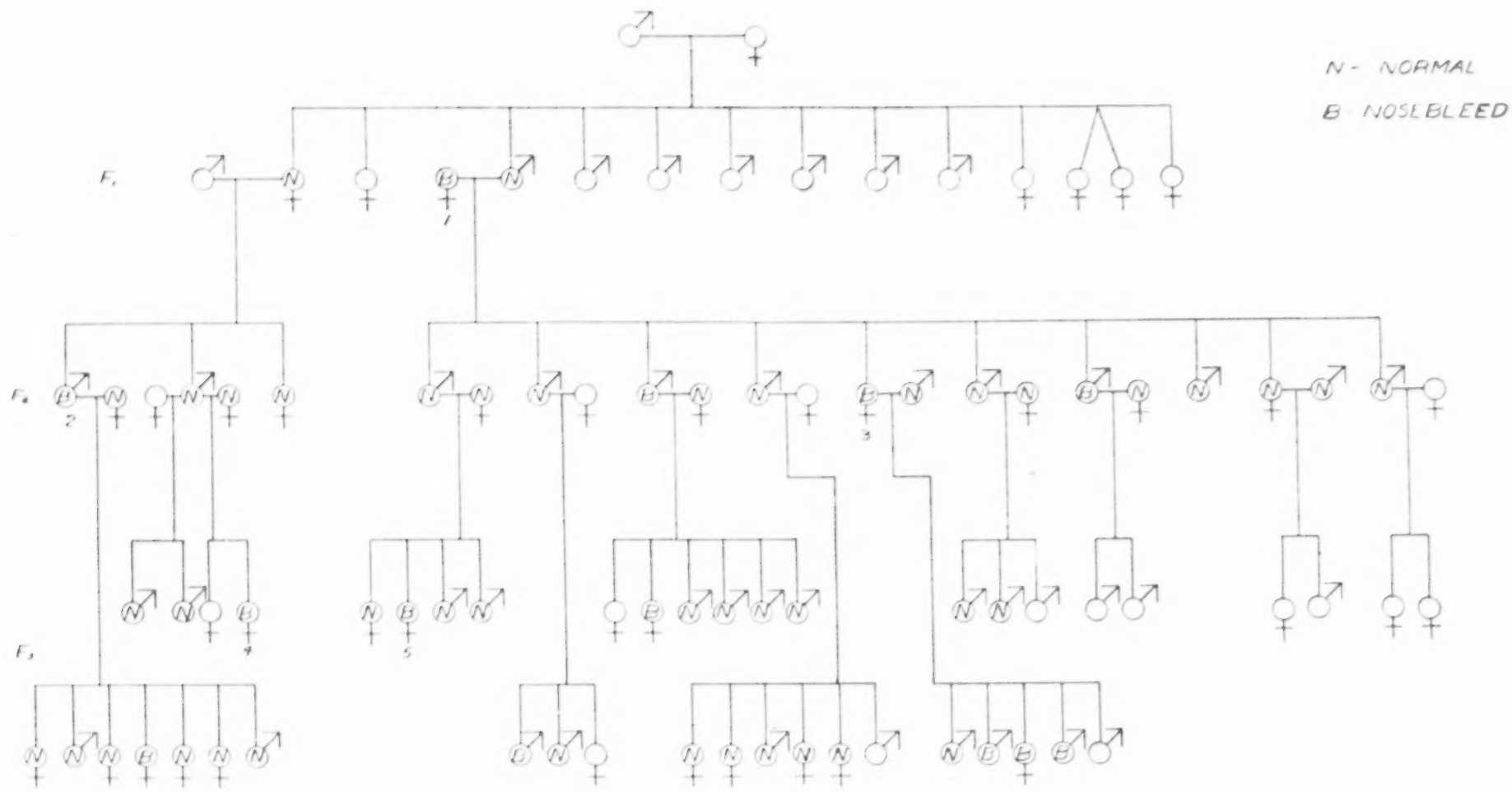
Individual No. 2 in the second generation exhibited the peculiarity most strongly. His nose would bleed profusely every day. This was especially marked in his sixteenth year, and yet at this time there was a remarkable body growth. He worked very hard, seeming never to tire, and was never sick. The nose bleeding diminished the next year and ceased entirely in his eighteenth year.

Individuals Nos. 1 and 5 on the chart are characterized by typical vicarious menstruation in addition to the peculiar nose bleeding. The latter occurred quite regularly about three times a week and ceased at about the eighteenth year.

Individual No. 4 in the third generation also showed this peculiar vicarious function at times.

Individual No. 3 had nose bleed more or less frequently up to her death which resulted from an uncontrollable nose bleed at the age of 45. None of the other cases exhibited anything unusual

[1] Dr. Raymond Pearl, to whom thanks are hereby given, has criticized this paper and made valuable suggestions.



HOW NOSE BLEED IS INHERITED

Nothing is known about the first generation here charted, but from then on it appears regularly in some of the members of each generation. (Fig. 14.)

except the regular nose bleeding that ceased at the age of 18 to 20.

Considering that this peculiarity first manifests itself at puberty, it perhaps bears a very close relation to the developing sex organs. It may be that the internal secretions of the gonads are being poured into the system and stimulating blood formation faster than the body can take care of it, and the excess blood leaves the body by breaking through the mucous membrane of the nose. The superabundance of blood would help to account for the rapid development and increased activity at this period. As the internal secretions and the body came to be adjusted to each other, we may suppose that the phenomenon diminished and finally disappeared (with the one exception).

Davenport[2] gives a few cases of diseases of the blood and with evidence that the tendencies are inherited. The peculiarity herein described is probably very similar or the same as one Davenport gives under the caption "Nose bleed (Epistaxis)."

This trait differs from hemophilia in that it occurs in both sexes, only for a few years, and then disappears; and to all appearances the blood coagulate normally.

Some people who suffer from catarrh have frequent but irregularly occurring nose bleed. This is usually due to the erosion of the mucous membrane and generally is induced by slight injuries, and is in no way correlated with sex development.

One frequently encounters people who have a hypersensitive nose, so that very slight injuries result in bleeding. This trait usually is apparent long before puberty; if proper precautions are taken bleeding does not occur; and the absence of bleeding is not followed by depression. In fact these cases are apt to be weakened by bleeding. Such bleeding seems to result from high pressure of blood on very thin and delicate membranes. It is altogether possible that individual No. 3 on the chart was of this type.

The accompanying chart well shows the distribution of the trait in question. The blank spaces in the first and second generations are those from whom no data have so far been obtained regarding the trait. The blank spaces in the third generation represent individuals

[2] Davenport, C. B. "Heredity in Relation to Eugenics," p. 153. New York, 1911.

who have not yet passed childhood. There are a number of children already in the fourth generation and it will be interesting to watch their development and those of the third generation to see whether new cases of nose bleed appear.

The maladjustment between blood formation and the body requirements may be inherited. At present all that can be said, from the data we have, is that it occurs in three generations of one family. Further search may reveal its appearance in more of the first generation or of their descendants, and time may prove its development in the fourth generation.

The Tendency to Multiple Births

One of the most extraordinary cases of human fecundity is that recalled by R. Berger in the Zentralblatt für Gynäkologie (1914, 10) on the authority of the "Gessellschafter von 1834." The case is that of a man whose first wife had quadruplets four times, triplets three times and twins ten times; and whose second wife had triplets once and twins ten times. The man was, therefore, the father of sixty-eight children. Dr. Berger assumes, as both wives of the man were thus fecund, that the tendency to multiple births was due to the father rather than the mother; but the idea seems hardly tenable, for the production of several children at once is naturally due to the production of several ova at once, and it is hardly conceivable that the father has any influence in the production of ova. Yet as a recent study of the inheritance of twinning in sheep has likewise seemed to indicate a slight influence on the part of the sire, in the production of twins, the whole question deserves a careful examination.

Immigration after the War

European emigration to the United States is likely to increase after the war, according to Professor Robert De C. Ward of Harvard University, who writes in the *Eugenics Review* (London, January, 1916). At the same time, the physical and mental quality of the immigrants is likely to show a decrease over the standard which has prevailed in the past. A serious situation is therefore confronting eugenists. As measures which will aid in preventing the deterioration of the national stock, Dr. Ward suggests a heavier fine for steamship companies which attempt to bring mentally defective aliens to the United States, more thorough examination of immigrants at port of entry, extension from three to five years of the time in which an immigrant may be deported if he becomes insane, and an extension of the list of classes of immigrants who are excluded altogether. But more effective than any single measure, Dr. Ward thinks, would be a measure which would restrict immigration in general. He favors some such provision as the *reading test* embodied in the Immigration Bill which was vetoed last year by President Wilson.

TRIPLET CALVES

Some Families of Cattle Produce Many of Them, Others None—Heredity Involved But Its Working Not Simple—Attempt to Breed a Strain of Livestock That Will Produce an Unusual Number of Young Seems Practicable

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IF animals which normally produce only one offspring at a birth could be made, without loss of any desirable qualities, to produce two or three, it would be a distinctly practical application of genetics. One of the necessary preliminaries to such a step is a careful study of cases where twins or triplets are born.

It is not very uncommon for a cow to produce twin calves, but triplets are decidedly rare. One set of them[1] is shown in the accompanying photograph (Fig. 15) from their owner, N. P. Sorensen, of Bellingham, Wash.

This particular case is somewhat puzzling because it seems to be isolated. So far as is known, the mother of these triplets had never produced more than one calf at a time, previous to this; and the sire is not known to have produced any other triplets or twins. Furthermore, the strain to which they belong appears to be no more prolific of twins or triplets, than is any other strain of Holstein-Friesians.

The three calves have grown normally, and the two bulls promise to be valuable breeders. The heifer, however, does not give any indication of sexual maturity, and it is probable that she is what stock men call a "free martin," an infertile female born as a twin to a male (or two males, in this case).

Although no other plural birth has been recorded for this family, it is usual to find, where such a case is investigated, that several plural births have occurred. Raymond Pearl, for example, in tracing the history of the triplet calves shown in Fig. 16, found[2] that their dam had the following record:

Three offspring, one at a time; then two pairs of twins in succession; next triplets; then a single calf and finally the pair of triplets represented in the photograph.

It would appear that, as the cow grew older, the tendency to multiple births increased.

Information in regard to the ancestry was not available in this case, but E. N. Wentworth has reported[3] an instance of twins in three generations, on a farm near Cocheco, N. H.

MODE OF HEREDITY

Data for investigating the heredity of this tendency in livestock are naturally scanty, but in man they are more abundant. The fact that a tendency to bear twins is due to inheritance, is pretty generally accepted, but no one has yet been able to say *how* this

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[1] The mother of these calves is Eldred Clothilde's Josephine 2d, a purebred Holstein-Friesian cow (registry No. 23525) belonging to the famous De Kol strain from which most of the fine Holsteins in the United States are derived. Her sire was De Dikkert 3d's De Kol Paul, 23525, and her dam Eldred Clothilde's Josephine, 50837.

In February, 1910, the cow illustrated was purchased by N. P. Sorensen, of Bellingham, Wash., and since then has produced the following calves:

Caroline Josephine, born May 10, 1910; female 160284.
Adriana Josephine, born April 16, 1911; female 163034.
Sir Johanna Aaggie of Mt. Springs, born April 24, 1913; male 139860.
Joe de Kol, born May 9, 1914, male 154992.
Joe de Kol 2d, born May 9, 1914; male 154993.
Josephine 3d, born May 9, 1914; female, not registered.

The last three calves named are the triplets shown in Fig. 15. The mother was born October 28, 1904. The sire of the triplets is Sir Johanna Aaggie Fayne 10th (No. 81867).

[2] Bull. 204, Maine Agricultural Experiment Station, September, 1912.

[3] Breeder's Gazette, Vol. LXII, p. 133, July 24, 1912.

THREE CALVES AT A TIME

After bearing a single calf three times in succession, the Holstein-Friesian cow here shown suddenly bore triplets. As little is known of her ancestry, it has been impossible to find to what extent heredity is responsible for this multiple birth. From other studies, it is known that heredity is one of the causes of such births. If a thorough investigation of many cases like this were made, ways might be found for getting a strain that would regularly produce at least two calves at a time, instead of one. (Fig. 15.)

tendency is inherited, for the results are irregular. W. Weinberg, whose study dealt with large numbers of cases, decided[4] that in man the tendency toward multiple births is inherited in Mendelian fashion, apparently behaving as a recessive; but the results did not altogether bear out this simple statement, and he concluded that although heredity was at the bottom of it, external factors also played an important part. No single external factor was as important as heredity, he thought, but the sum total of external factors was probably more important than heredity.

Weinberg's methods of investigation, being statistical, were hardly sufficient to decide this point, and all that can be said at present is that heredity is at least an important factor in the production of plural births.

Few attempts to increase the fecundity of a strain by selecting the animals which produce an unusual number of young, are on record. To a certain degree, of course, such selection is always going on, half unconsciously, for animals which are poor breeders are discarded, while those which are good breeders are valued highly and bred

[4] Archiv für Rassen- und Gesellschafts-Biologie, Band 6, pp. 339, 470, 609, 1909.

THEIR MOTHER HAD FOURTEEN CALVES AT EIGHT BIRTHS

She is a grade Guernsey, while the sire was a grade Hereford. The male calf (in the center) resembled his mother in color and markings, while the other two (infertile females or "free martins") inherited the color and markings of their father, including the white face which is so characteristic of the Hereford breed. Photograph reproduced by courtesy of the Maine Agricultural Experiment Station. (Fig. 16.)

regularly. But deliberate attempts, extending over a series of generations, have rarely been made.

EXPERIMENT OF DR. BELL

One of the most notable experiments is that of Alexander Graham Bell, who for a quarter of a century bred his sheep steadily with a view to getting the ewes to produce more young at a birth. His method of procedure[5] was to select for breeding each year the ewes which had extra nipples, above the single pair regularly present. There appears to be an association between extra nipples and extra fecundity. When Dr. Bell disposed of his flock, a short time ago, he had built it up to a point where none of the ewes had less than four nipples and many of them six, and where twins were produced in a large majority of the births.

Having kept a careful record of his flock, Dr. Bell was able to find some of the external conditions that seem to be involved in the production of twins in sheep. Among them are maturity of the mothers, mating in October, and a rapid increase of weight at the time of mating with subsequent loss of weight. The last-named factor was controllable, and he had some success in increasing the number of twins born, by feeding up the sheep just before mating, and letting them lose weight afterward.

So far as is known to the writer, no such attempt at breeding for fecundity has ever been made with cattle. It would be a tedious and expensive undertaking, but if the character is really inheritable, one ought to be able to breed it into other animals, after it had once been "fixed" in a given strain. It would therefore appear that the attempt to produce a family of cows that would yield a large proportion of twins and triplets, might be a practicable and profitable proceeding.

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[5] See THE JOURNAL OF HEREDITY, Vol. V, No. 2, pp. 47–57; February, 1914.

WILD TURKEYS

Domesticated by American Aborigines—Hybridity of Present Stocks—Habits of Birds in the Woods—Changes Produced Under Domestication

Review of a Book by EDWARD A. MCILHENNY, *Avery Island, La.*

LARGE and handsome, the wild turkey has inevitably attracted constant attention since the days of the first explorers of America. The literature to which it has given rise is considerable, but it is doubtful whether any writers give a more accurate close-range view of the fowl than do those of the book here reviewed.[1]

As to the first appearance of the bird on this continent, authorities differ. Marsh described a species under the name of *Meleagris altus* from the Post-pliocene deposits of New Jersey, which is now held to be the same as Cope's *M. superba* from the Pleistocene of the same state. The material on which this species was based consisted of a few damaged leg-bones, which Dr. Shufeldt, who reviews the subject in the present book, thinks may not have belonged to a turkey at all. The same may be said of another of Marsh's prehistoric species, *M. antiquus*, described from a wing-bone found in Colorado; and to still another species, *M. celer* Marsh, re-created from a few doubtful bone fragments which, it is admitted, may not all have belonged to the same individual.

In short, a careful re-examination of the case shows no well-authenticated turkeys in the geologic record of America. Doubtless they existed, but we have not the material to prove it; and, as Dr. Shufeldt says, "It is often a positive detriment to science, in my opinion, to create new species of fossil birds upon the distal ends of long bones, and surely no assistance whatever to those who honestly endeavor to gain some idea of the avian species that really existed during prehistoric times."

When we come to the historic period, however, we at once find the turkey in practically all the wooded country of North and Central America. The first description seems to have been given by Oviedo in the thirty-sixth chapter of his "Summary of the Natural History of the Indies," which appeared about the year 1527. "He speaks of it as a kind of Peacock found in New Spain, of which a number had been transported to the islands of the Spanish Main and domesticated in the houses of the Christian inhabitants."

IMPROVED IN MEXICO

The Spaniards found them thoroughly domesticated in Mexico, the tame breed having been brought to a size twice that of the wild birds, and the Aztec emperor Montezuma is said to have raised thousands of them to feed the animals of his zoological garden. From Mexico or Yucatan they were introduced to Europe, having reached England, apparently, as early as the year 1524, and quickly becoming very plentiful there. From England and Spain they spread over the rest of the continent.

As the Mexican turkey differs in many respects[2] from those of the United

[1] The Wild Turkey and Its Hunting. By Edward A. McIlhenny. Illustrated from photographs. Pp. 245, price $2.50 net. New York, Doubleday, Page & Co., 1915. The book was written by Mr. McIlhenny largely from notes left by Charles L. Jordan; two chapters are contributed by Dr. R. W. Shufeldt, of Washington, D. C.

[2] The systematic position of the various turkeys has been much disputed. At present the North American forms are all credited to one species, *Meleagris gallopavo*, the type of which is furnished by the Mexican bird, while four subspecies are distinguished in the United States. In Greek and Latin the name Meleagris designated the Guinea-fowl, and the early writers on the turkey appear to have thought they were dealing with a variety of that bird. The name *Turkey* was formerly thought to be related in some way to the Turks, but is now believed to be either an American Indian name or to be derived from the call of the bird itself.

WILD TURKEYS COMPETING FOR A MATE

These two males have been attracted by a photographer, who is hidden in the brush and imitating, with a caller, the love note of the turkey hen. The males stalk up and down, in such a case, and go through an elaborate performance for the purpose of impressing the hen. The one at the left is just beginning the "strut," which is described in the text. Photograph from "The Wild Turkey and Its Hunting." (Fig. 17.)

States, the result has been that the domesticated turkeys of Europe differ somewhat from those of the United States. During the last century the various forms have been crossed and intercrossed in the United States, so that the domestic flocks of bronze turkeys mostly contain recent infusions of wild-turkey blood, while the wild flocks have a great deal of domestic blood. On this point we read:

"In countries thickly settled, as in the one where I now write, there is a great variety of wild turkeys scattered about in the woods of the small creeks and hills. Many hybrid wild turkeys are killed here every year. The cause of this is: every old gobbler that dares to open its mouth in the spring is within hearing of farmers, Negroes, and others, and is a marked bird. It is given no rest until it is killed; hence there are few or no wild turkeys to take care of the hens, which then visit the domestic gobbler about the farmyards. Hence this crossing with the wild one is responsible for a great variety of plumages.

"I once saw a flock of hybrids while hunting squirrels in Pelahatchie swamp, Mississippi, as I sat at the root of a tree eating lunch, about 1 o'clock, with gun across my lap, as I never wish to be caught out of reach of my gun. Suddenly I heard a noise in the leaves, and on looking in that direction I saw a considerable flock of turkeys coming directly toward me in a lively manner, eagerly searching for food. The moment these birds came in sight I saw they had white tips to their tails, but they had the form and action of the wild turkey, and it at once occurred to me that they were a lot of mixed breeds, half wild, half tame, with the freedom of the former. I noticed also

among them one that was nearly white and one old gobbler that was a pure wild turkey; but it was too far off to shoot him. Dropping the lunch and grasping the gun was the work of but a second; then the birds came round the end of a log and began scratching under a beech tree for nuts. Seeing two gobblers put their heads together at about 40 yards from me, I fired, killing both. The flock flew and ran in all directions. One hen passed within 20 paces of me and I killed it with the second barrel. A closer examination of the dead birds convinced me that there had been a cross between the wild and the tame turkey. The skin on their necks and heads was as yellow as an orange, or more of a buckskin, buff color, while the caruncles on the neck were tinged with vermilion, giving them a most peculiar appearance; all three of those slain had this peculiar marking, and there was not a shadow of the blue or purple of the wild turkey about their heads, while all other points, save the white tipped tail feathers, indicated the wild blood."

INCREASE IN BRAIN POWER

It appears that there are numerous small anatomical differences between the typical wild and typical tame turkey, one of them being a difference in the size of the brain cavity. "Mentally the average wild turkey is stronger than the average domesticated one, and I believe it will be found that in all these long years the above influences [of domesticity] have affected the size of the brain-mass of the latter species in the way above indicated, and perhaps it may be possible some day to appreciate this difference. Perhaps, too, there may have been also a slight tendency on the part of the brain of the wild turkey to increase in size owing to the demands made upon its functions due to the influence of man's nearer approach and the necessity of greater mental activity in consequence."

Data are still lacking to determine precisely the extent to which the wild turkey changes in a few generations of domestication. J. D. Caton, who has bred many wild turkeys in captivity, writes on this point:

"My experiments establish first that the turkey may be domesticated, and that each succeeding generation bred in domestication loses something of the wild disposition of its ancestors. Second, that the wild turkey bred in domestication changes its form and the color of its plumage and its legs, each succeeding generation degenerating more and more from these brilliant colors which are so constant in the wild turkey of the forest, so that it is simply a question of time—and indeed a very short time—when they will lose all their native wildness and become clothed in all the varied colors of the common domestic turkey; in fact, be like our domestic turkey—yes, be our domestic turkey."

The loss of this plumage must be a bitter pill for the male to swallow, if we are to accept the picture of him which is vividly painted for us. He is a regular Turk, we are informed, polygamous in the extreme and desirous above all of a well-filled harem. "He cares not a bit for the rearing or training of his family; in fact, it has been alleged that he follows his mates to their nests and destroys and eats the eggs. This I do not believe, nor will I accuse him of such conduct. He is a vain bird and craves admiration, and acts as if he were a royal prince and a genuine dude, and he will have admiration though it costs him his life. He is a gay Lothario and will covet and steal his neighbors' wives and daughters; and if his neighbors protest, will fight to the finish. He is artful, cunning, sly, at the same time a stupendous fool. One day no art can persuade him to approach you, no matter how persuasively or persistently you call; the next day he will boldly walk up to the gun at the first call and be shot. He has no sentiment beyond a dudish and pompous admiration for himself, and he covets every hen he sees. He will stand for hours in a small, sunny place, striving to attract the attention of the hens by strutting, gobbling, blowing, and whining, until he nearly starves to death. I believe he would almost rather be dead than

to have a cloudy day, when he is deprived of seeing the sun shining on his glossy plumage; and if it rains, he is the most disconsolate creature on the face of the earth."

SEXUAL SELECTION

Thanks to the activity of hunters, males are much fewer than females; consequently the polygamous nature of the bird is favored. Beyond this, however, it appears that there is a considerable amount of sexual selection, many gobblers having large harems while others remain unmated. At mating time the males often fight each other, but the writer contradicts Audubon's statement that the weaker are then killed by the stronger. "I have seen many encounters as he describes, but have never in all my life seen one gobbler killed by another, or even crippled, although I have seen two or three birds fight together for hours at a time. Nor have I ever found a gobbler dead in the woods as the result of such an encounter, or even in a worried condition. I have killed many old gobblers and found their necks and heads covered with blood, with spur punctures all over their breasts; but this never stopped them from gobbling, nor are these wounds deep, as the spur, which is an inch and a quarter long in the oldest of them, can only penetrate the skin of the body after passing through the heavy mail of the thick, tough feathers."

Although such an idea is regarded with disfavor by many biologists at the present time, the writer's account indicates that he considers sexual selection to be dependent principally on the selective choice of the hens, whom the males endeavor to attract by the well-known "gobble," and a variety of other evolutions which are thus described:

"In the early morning, during the spring, a gobbler will fly from his roost to the ground, strutting and gobbling, whether a hen is in sight or not; this is done to attract the hens, and it is then you will hear the puffs to which Audubon refers. This sound is produced by the gobbler in expelling the air from its lungs, at the beginning of the strut, the sounds and motions of which have never been satisfactorily described. While going through the strut the gobbler produces a number of notes and motions that are of interest; first, the wings are drooped until the first six or eight feathers at the end of the wings touch the ground; at the same time the tail is spread until like an open fan and erected at right angles to the body; the neck is drawn down and back until the head rests against the shoulder feathers, and the body feathers are all thrown forward until they stand at about right angles to their normal place. At the same time the body is inflated with air, which, with the drooping wings, spread tail, and ruffled feathers, gives the bird the appearance of a big ball. Having blown himself up to the full capacity of his skin, the gobbler suddenly releases the air, making a puff exactly as if a person, having inflated the cheeks to their full capacity, suddenly opens the mouth. As the puff is given, the bird steps quickly forward four or five paces, dragging the ends of the stiff wing feathers along the ground, making a rasping sound; he throws forward his chest, and, gradually contracting the muscles, forces the air from his body with a low, rumbling boom, the feathers resuming their normal position as the air is expelled. Three distinct sounds are produced: *Puff*, *cluck*, *b-o-o-r-r-r-m-i*. At the termination of the gobbling season the primaries of the wings, which are used to produce the cluck, are badly worn by the continued dragging on the ground."

PRESERVING THE TURKEY

A performance of this sort is naturally conspicuous and since the days of Audubon it has been prophesied that the wild turkey would soon become extinct, due to the activity of hunters who follow his call from considerable distances (it is said the gobble can be heard for two miles in favorable atmospheric conditions). There is no game, however, we are told, that holds its own so well as the wild turkey. In the southern states the bird is still to be found in reasonable abundance, and, says the writer, "if these states will protect them

by the right sort of laws, I am of the opinion that the birds will increase rapidly, despite the encroachment of civilization and the war waged upon them by sportsmen. It is not the legitimate methods of destruction that decimate the turkey ranks, as is the case with the quail and grouse, but it is the nefarious tricks the laws in many states permit, namely, trapping and baiting. The latter is by far the most destructive, and is practiced by those who kill turkeys for the market, and frequently by those who want to slaughter these birds solely for count. No creature, however prolific, can stand such treatment long. The quail, though shot in great numbers by both sportsmen and market hunters, and annually destroyed legitimately by the thousands, stand it better than the wild turkey, although the latter produces and raises almost as many young at a time as the quail.

"There are two reasons for this: One is, the quail are not baited and shot on the ground; the other reason is that every bobwhite in the spring can, and does, use his call, thus bringing to him a mate; but the turkey, if he dares to gobble, no matter if he is the only turkey in a radius of 40 miles, has every one who hears him and can procure a gun, after him, and they pursue him relentlessly until he is killed. Among the turkeys the hens raised are greatly in excess of the gobblers. This fact seems to have been provided for by nature in making the male turkey polygamous; but as the male turkey is, during the spring, a very noisy bird, continually gobbling and strutting to attract his harem, and as he is much larger and more conspicuous than the hens, it is only natural that he is in more danger of being killed. Suppose the proportion of gobblers in the beginning of spring is three to fifteen hens in a certain stretch of woods. As soon as the mating season begins, these gobblers will make their whereabouts known by their noise; result—the gunners are after them at once, and the chances are ten to one they will all be killed. The hens will then have no mate, and no young will be produced; whereas, if but one gobbler were left, each of our supposed fifteen hens would raise an average of ten young each, and we would also have 150 new turkeys in the fall to yield sport and food. It has always been my practice to leave at least one old gobbler in each locality to assist the hens in reproduction. If every hunter would do this the problem of maintaining the turkey supply would be greatly solved."

The Age of Parenthood

There is a widespread idea that people formerly married very early in life, and now marry very late. Census figures have demonstrated that as far as concerns the United States, during the past half century, young people are marrying today at an earlier average age than formerly. Genealogical data compiled by Charles Nutt of Worcester, Mass., indicate that five or six generations ago marriage took place at about the same time as nowadays. In the Colonial period, he finds that the average age of parents at the time their children were born is about 31 years. This is an indirect way of getting at the facts, but it tallies with the investigation of C. L. Redfield, who found that the average age of fathers was 32 and of mothers 29, in a large number of New England families. As families were larger formerly than now, it is evident that parallels between the ages of parents then and now must be drawn with care, if based on such averages as those here given.

BREEDING FARM CROPS IN IOWA

H. D. HUGHES, *Ames, Iowa*

THE Farm Crops Section of the Iowa Experiment Station has under way breeding projects with oats, winter wheat, barley, corn, timothy, and red clover.

1. *Oat Breeding.* (In cooperation with Bureau of Plant Industry, United States Department of Agriculture.)

The present projects in oat breeding were begun in 1906. The work consists primarily, first, of isolating and testing pure lines from commercial varieties, and second, breeding pure lines from crosses.

Several hundred pure lines have been isolated annually from the various commercial varieties which have given greatest promise in our variety test plats. These pure lines have been tested in head and nursery rows for growth, vigor, and productivity. Those which appeared most promising have been increased and tested under field conditions. In all, something over 8,000 pure lines have been isolated and tested during the years 1906 to 1914. One hundred and twenty-five pedigreed varieties are now included in our variety tests. Two of the most promising have been distributed to farmers in sufficient lots to plant one acre of each, the pedigreed oats being compared under field conditions with the best commercial varieties which the farmers have been able to secure. In 1913 the pedigreed oat, "Iowa 103," outyielded commercial varieties approximately five bushels per acre. In 1914 the pedigreed varieties, "103" and "105," each outyielded the commercial varieties more than four and one-half bushels per acre.

Prior to 1908, J. D. Norton, of the Bureau of Plant Industry, made a large number of crosses. The product of these crosses was transferred to the Iowa Experiment Station in 1909. Several thousand selections have been made and tested in the nursery. The most promising of those that have proved to be pure lines have been increased and are being tested in the variety test plats and comparisons made with commercial varieties and other pure lines.

2. *Winter Wheat Breeding.*

This project started from a foundation stock of eleven different varieties in 1906. From these, several hundred pure lines have been selected and tested out annually in head and nursery rows. During the past four years at least 500 heads have been secured annually from fields away from the station. During the years 1906 to 1914 approximately 8,000 pure lines have been tested out and either multiplied or discarded. Some 150 pedigreed strains are under comparison in twentieth-acre plats and others are being compared in tenth-acre plats. Seed sufficient to plant one acre of the two most promising and best growing varieties, "Iowa Nos. 404 and 327," have been distributed to each of a number of farmers in various portions of the State, these to be compared with a plat of similar size planted under the same conditions, using the best commercial seed which they could get. In 1913 these pedigreed varieties outyielded the commercial sorts an average of one and one-half bushels per acre.

3. *Barley Breeding.*

This project was begun in 1911, the object being to produce strains or varieties of barley suitable for brewing purposes and which could be successfully grown on the drift soils of Iowa. After comparing various varieties in variety test plats for several years, pure lines were isolated from the most promising, these being tested out in head and nursery rows.

4. *Breeding Silver King Corn for Northern Iowa.*

This work was begun in the spring of 1910 when 300 of the best ears of Silver King corn which could be secured were planted in ear to row trials. During

the five years 1910 to 1914 over 1,000 ears have been tested out in this way. Approximately 10 per cent. of the mother ears showing the best performance have gone into the crossing plats, the best of these crosses going into multiplication and into field trials. Some fifty-seven crosses have been tested out at the breeding stations and the progeny of about ten of these crosses has been distributed to several hundred farmers in the northern part of the State for comparison with their own corn. In 1913 the improved Silver King outyielded all varieties with which it was compared, an average of approximately five bushels per acre.

5. *Reid's Yellow Dent Breeding Work.*

A definite project looking to the improvement of the ordinary Reid's Yellow Dent was begun at Ames about 1905. From 1905 to 1914 over 2,000 selected ears of Reid's Yellow Dent corn have been tested out in ear to row plats. The ears showing the best field performance are carried over each year to go into the crossing plat.

One very desirable strain known as "Iowa 203" has been developed, which, in test trials, has an average of about twelve bushels per acre over ordinary Reid's from which it came. Enough corn to plant one acre was supplied last year to each of several hundred farmers in central Iowa for comparison with their own corn.

6. *Breeding Red Dent Corn.*

The purpose of this investigation is to determine the prepotency of the color character in Reid's Yellow Dent corn. This investigation was begun in 1913, so that it has been under way for only two seasons. During each of these seasons the per cent of red and yellow ears produced by different shades of red mother ears as well as by yellow ears with red parentage has been noted. In 1914 some 20,000 hills were included in the test.

7. *Correlation Studies with Corn.*

The object of this investigation is to determine the relation between the ear characteristics of seed ears and yield, also the relation between the stalk characteristics of the plant producing the seed ear and the yielding power of the ear.

The characteristics of the various seed ears which have been planted in ear to row test plats have been noted in a study of the relation between the character of the ear and yield. So far the work has consisted simply in securing the data. We propose to compile this data in the near future. This part of the work was begun in 1907.

The study of stalk characteristics as related to yield was begun in 1910 when full and detailed notes were made on the characteristics of some 500 stalks grown under different climatic conditions. The ear produced by each stalk was saved and planted in a separate plat the second year, when the yield was determined. From 400 to 500 individual plants and an equal number of plats have been used in this work each year. While but little of this data has been compiled, we believe that some rather striking correlations between the character of the stalk and the yielding power of the ear will be found.

8. *Timothy Breeding.*

This project was begun in 1910 when some 3,000 plants were put out in the nursery. From approximately 300 strains compared in row trials some twenty have been advanced to multiplication plats where they are under further comparison. A few of the best of these will be placed in isolated multiplication plats the coming fall.

9. *Clover Breeding.* (In cooperation with Bureau of Plant Industry, United States Department of Agriculture.)

This project was begun in 1910 when a large number of selections were made from specimens secured in the vicinity of Ames, Iowa. In 1912 we secured from the Bureau of Plant Industry of the United States Department of Agriculture various lots of seed coming from all parts of the world. These were planted in nursery plats where individual plants were seeded and the best individuals isolated for continued breeding and multiplication. Some fifty-five of the best individuals have been multiplied and are being compared for vigor, leafiness, seed production, and resistance to winter killing and disease.

Genetics Literature

THE annual reports of the AMERICAN BREEDERS' ASSOCIATION, published in seven volumes, form the most valuable collection of material for students of genetics which has been published in the United States. Most of them are out of print and are becoming very valuable. All of them are nearly indispensable to libraries, institutions and students of plant and animal breeding, heredity, variation, eugenics, or genetics in general.

The Association still has on hand a limited number of copies of three of these reports, which it offers for sale.

Vol. VI, Proceedings A. B. A. (1910), contains 465 pages. Illustrated. It includes 80 papers on general genetic subjects, and among the contributors are practically all the leaders in this study in the United States. **Issued at $2, now offered for $1.**

Vol. VII, Proceedings A. B. A. (1911), and Vol. VIII (1912), bound in one volume of 593 pages, illustrated, and including 73 monographs on the most vital and interesting features of genetics. **Issued at $3, now offered for $1.50.**

The volumes are substantially bound in cloth and will be sent post-paid on receipt of price.

As the Association frequently receives requests for other volumes of the proceedings, which are now out of print, it will be glad to hear from those who have copies for sale or exchange.

In addition to its annual reports, the Association still has on hand a few copies of the following issues of the AMERICAN BREEDERS' MAGAZINE:

Vol. I, Nos. 2 and 4.
Vol. II, Nos. 3 and 4.
Vol. III, No. 2.
Vol. IV, Nos. 1 and 4.

JOURNAL OF HEREDITY:

Vol. V, Nos. 5, 6, 7, 8, 9, 10, 11 and 12.
Vol. VI, Nos. 2, 3, 4, 5, 6, 7, 9, 10, 11 and 12.

Each of these issues contains numerous articles on plant and animal breeding and eugenics, written by specialists and in most cases describing the results of their own researches. In many instances these researches have never been described elsewhere. These numbers will be sold for 25 cents each, post paid.

Address

THE AMERICAN GENETIC ASSOCIATION

511 Eleventh Street Northwest **WASHINGTON, D. C.**

WHAT GENETICS IS

"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

To gain this knowledge is the object of the science of genetics, which proceeds, in practice, largely by means of plant breeding and animal breeding, for the reason that heredity is less complicated in these organisms than in Man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race through the science of eugenics, which was defined by its founder, Francis Galton, as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally."

THE AMERICAN GENETIC ASSOCIATION

is an incorporated organization, co-operative in nature and devoted to promoting knowledge of the laws of heredity in the broadest sense of the word, and their application to the improvement of plants, animals, and human racial stocks. It is the largest organization in the world for the advancement of genetics, and its organ, The Journal of Heredity, is the most important agent for furthering the interchange of ideas between investigators of different phases of these problems, and for the presentation of their results to the public.

Through its committees on research, co-operation with which is not obligatory, but is urged upon every member, the association collects information by means of approved scientific methods applied to the subject of genetics. This information, as well as that derived from other authoritative sources, it endeavors to place before the public by means of its committee on education and extension, and before its membership, in an attractive and understandable way, through this magazine. The association constantly strives to further the cause of conservative, constructive science and to check the progress of fallacious and sensational pseudo-science. While it can not assume responsibility for the accuracy of statements made by contributors to The Journal of Heredity, it endeavors to publish only such as are on a sound scientific basis, and members are urged to contribute such articles, with illustrations. The magazine does not pretend entirely to cover the immense field of genetics, but it is designed to keep members informed of the latest results in research in the most interesting lines, and to present these results in such a way that they will appeal not only to the specialists, but to the general reader who desires to know what the specialists are doing in a science that is of such personal importance to each individual.

REQUIREMENTS FOR MEMBERSHIP

Membership is composed of scientists, teachers, publicists, physicians, clergymen, students, horticulturists, and breeders of live stock, throughout the world. Subject to the approval of the council, any person interested in the improvement of the human race or the creation of better varieties of plants and animals, is eligible for membership. The secretary will be glad to correspond with those interested, and to send a copy of the magazine for examination. Annual dues, giving the right to attend all meetings and to receive the Journal of Heredity, are $2; life membership is $50. Address all communications to

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